1971

The diatoms of Clear Lake and Ventura Marsh, Iowa

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72-12,536

BEGRES, Forrest Mort, 1943-
THE DIATOMS OF CLEAR LAKE AND VENTURA
MARSH, IOWA.

Iowa State University, Ph.D., 1971
Botany

University Microfilms, A XEROX Company, Ann Arbor, Michigan

The diatoms of Clear Lake and

Ventura Marsh, Iowa

by

Forrest Mort Begres

A Dissertation Submitted to the

Graduate Faculty in Partial Fulfillment of

The Requirements for the Degree of

DOCTOR OF PHILOSOPHY

Major Subject: Botany (Aquatic Plant Biology)

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1971

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INTRODUCTION

During the past two decades, the diatoms of a great variety of Iowa habitats have been studied intensively. The bulk of these studies was supported by a grant from the Federal Water Pollution Control Administration (Project WP-00221) entitled "Ecology of diatoms in hardwater habitats," but much of the work, the present study included, has been supported by other agencies.

Many of these studies were concerned with the extant diatoms of lentic waters. Kutkuhn (1958) considered the diatoms in his study of the plankton of North Twin Lake. Small (1959) presented a list of important algal plankters, including seven diatom genera, in his study of the standing crop of plankton in Clear Lake. Volker (1962 and 1963) reported on the diatom flora of Lake East Okoboji and Stoermer (1963a) carried out an exhaustive study of the diatoms of Lake West Okoboji. Hostetter and Stoermer (1968) investigated the vertical distribution of Aufwuchs diatoms of Lake West Okoboji. Stoermer (1964) reported on some rare and little-known diatoms from Lake West Okoboji and Clear Lake. The diatom flora of an Iowa fen was considered by Shobe, Stoermer and Dodd (1963). Ohl (1964 and 1965) studied the diatoms of Iowa farm ponds. Raschke (1968) included diatoms in his investigation of a tertiary sewage stabilization pond. Christensen (1969) discussed members of the genus Eunotia from an acid lake. These studies have added greatly to our knowledge of the composition and ecology of the Iowa diatom flora.

Several of the works mentioned above were conducted in areas somewhat comparable to Clear Lake and Ventura Marsh, Stoermer (1964) and

Small (1959) having even reported on some Clear Lake diatoms. However, no thorough investigation of the diatom flora of a shallow prairie lake or a marsh has heretofore been reported in Iowa. Clear Lake and Ventura Marsh were selected for this study not only because of the possible comparison of these differing but contiguous bodies of water, but also because Clear Lake has been and continues to be the subject of many biological investigations--particularly by the Iowa Cooperative Fisheries Unit.

The algal flora of Ventura Marsh has apparently not been investigated and the algal flora of Clear Lake has been treated only superficially from a floristic standpoint. In addition to the works already mentioned, Shimek (1897) mentioned a few species of green algae from Clear Lake in his study of aquatic plants from northern Iowa and Prescott (1931) reported on a variety of non-diatom algae from the lake. Meyer (1899) published the first work dealing with Clear Lake diatoms, but he dealt only with 10 of the more robust taxa. Pearcy (1953) reported on both the diatom and non-diatom algal flora of the lake.

The world literature contains innumerable studies of the diatom floras of lakes, but few are directly comparable to the present study. The vast majority of them are based on the examination of only a few samples collected during a limited time period and they frequently provide little or no information on the physical and chemical nature of the lakes. A large number of the reports consist of little more than lists of taxa observed and contain no ecological information. However, the studies of Cleve-Euler (1932), Foged (1954), Gandhi (1964), Hustedt (1922 and 1959a), Jurilj (1954) and Stoermer (1963a) were carried out in such detail as to permit valid comparisons with the present study.

The primary goal, and indeed the most time- and energy-consuming aspect of this study, was to investigate and report the diatom flora of Clear Lake and Ventura Marsh. The present state of diatom taxonomy is such that one could hardly attempt a study of this kind without devoting a great deal of time to solving taxonomic problems. Many diatom taxa are morphologically variable and yet, too frequently, the descriptions fail to adequately define the variability of the taxa being described.

A need for placing major emphasis on the autecology of the taxa found in the two study areas was recognized. Furthermore, an attempt to characterize the diatom flora of the major habitats examined and to correlate, when possible, the nature of these populations with the physical and chemical condition of their environment appeared to be essential. Finally, it became evident that an effort to describe and compare the structure of the diatom communities of the two study areas as a whole would be a useful summary.

One of the values of works such as this one lies in their usefulness to future workers and, in this connection, I felt that properly curated specimens of all taxa identified should be incorporated into the diatom herbarium of the Department of Botany of Iowa State University and that all taxa should be illustrated in the body of the thesis.

MATERIALS AND METHODS

Description of Study Areas

Clear Lake (Fig. 1) is a hard water, eutrophic, unstratified lake located in Cerro Gordo County, north central Iowa. Some limnological features of the lake have been described by Pearcy (1953). His observations include the following morphometric data (I have converted his figures to the metric system):

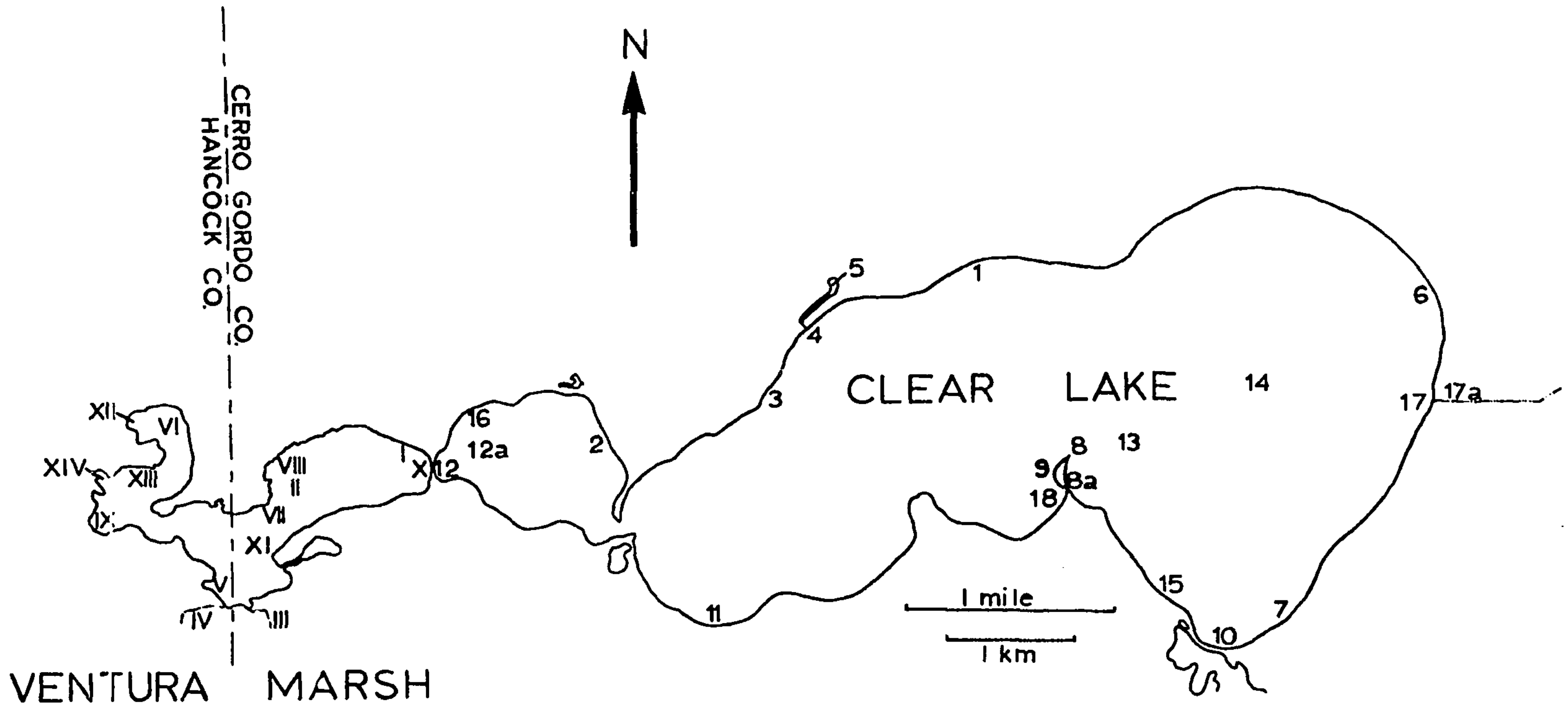
Length	7.7 km
Maximum width	3.4 km
Maximum depth	6.1 m
Average depth	3.6 m
Area of lake	14.74 km^2
Area of watershed	33.99 km^2
Shore development	1.58

No permanent surface streams enter the lake though many intermittent streams are present. Much of the water supply comes from springs and other underground sources. The bottom material near shore is mainly fine sand while a thick organic ooze predominates at depths of 1 to 1.5 meters and greater. However, the organic ooze frequently reaches the shoreline in the shallow west end of the lake.

Bachmann (1967), in his study of the chemistry of the surface waters of Iowa lakes, presented the following data for Clear Lake:

Specific conductance	306 micromhos at 25^{o}C
Alkalinity	143 ppm $CaCO_3$
Total hardness	146 ppm $CaCO_3$

Figure 1. Map of study areas showing location of Clear Lake collecting stations (arabic numerals) and Ventura Marsh collecting stations (roman numerals). —— ··· —— intermittent stream or drainage ditch


N
CERRO GORDO CO.
HANCOCK CO.
CLEAR LAKE
VENTURA MARSH
1 mile
1 km
1
2
3
4
5
6
7
8
8a
9
10
11
12
12a
13
14
15
16
17
17a
18
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
XIII
XIV

Calcium	23 ppm
Magnesium	22 ppm
Chloride	7.8 ppm
Sulfate	13 ppm

The relationship between air temperature and water temperature in the lake has been investigated by Jacobsen (1968). The primary productivity (Weber, 1963) and the phytoplankton standing crop (Small, 1959) of Clear Lake have also been studied.

Ventura Marsh (Fig. 1) lies to the west of Cerro Gordo County Road A, which separates the marsh from the lake, the western portion of the marsh extending into Hancock County. The contiguity of the two bodies of water is maintained by a narrow channel under the road. Water from the marsh enters the lake through this channel, though the flow is minimal during dry seasons. The marsh is very shallow and, with the exception of portions of the eastern end, is characterized by massive stands of emergent aquatic plants, especially Typha latifolia. The marsh occupies approximately 1.7 km^2, has a maximum depth of about 1 m at the eastern end and about 0.7 m elsewhere, a shore development of 2.5, and a muck bottom.

The lake and the marsh occupy a glacial basin on the Bemis end moraine at the eastern margin of the Des Moines glacial drift lobe of the Wisconsin glaciation. The Bemis moraine system is the oldest system in the Des Moines lobe and its basal drift has been dated at 14,000 years before present (Ruhe, 1969). The rather small watershed of the basin is characterized by Clarion loam, much of which is rolling phase, as well as significant areas of Webster silt loam and Webster silty clay loam. Although these soils have been leached to varying depths, calcium carbonate is abundant in the lower layers and in the underlying glacial till (Elwell et al., 1940 and Lesh, Benton, and Killinger, 1930).

Collecting and Preserving Techniques

Permanent collecting stations were set up in the two study areas, 21 stations on Clear Lake and 14 on Ventura Marsh (Fig. 1). These stations were selected on the basis of the variety of habitats they had to offer as well as their spatial distribution within the basin. Samples were collected during the period extending from 22 July 1968 to 5 August 1970. An attempt was made to collect a great variety of habitats and to collect during all seasons of the year. However, marsh collecting was not feasible during the winter months because as a management practice the Iowa State Conservation Commission lowered the water level in the marsh in mid-December and, as a result, it froze to within a few centimeters of the bottom by early January. No attempt was made to collect Aufwuchs and surface sediment samples at regular intervals, but 45 quantitative plankton samples were obtained at 2-week intervals during the period of 22 July 1969 to 8 July 1970. A total of 182 samples (117 from Clear Lake and 65 from Ventura Marsh) were collected and examined during the course of this study. A brief description of the samples is provided in Table 1. (Because all of the quantitative plankton samples were collected at one of two stations and were always collected in the same manner, they have not been included in the table).

Table 1. Description of samples (other than quantitative plankton) collected and examined during this study

Sample Number	Collection Date	Sta. No.	
1	22 July 1968	1	Surface plankton tow 32 m off shore (#25 mesh, 1-1.5 m water).
2	"	2	Scrapings from stems of Nymphaea tuberosa Paine.
3	"	2	Scrapings from underside of leaves of Nymphaea tuberosa Paine.
4	"	2	Surface sediment, 2-5 cm water (area somewhat protected by Scirpus bed).
5	"	2	Scrapings from stems of Nuphar variegatum Engelm.
6	"	2	Scrapings from culms of Scirpus validus Vahl., 60 cm water.
7	"	2	Rock scrapings, 15-30 cm water.
8	"	2	Surface plankton tow in open area of littoral zone (#25 mesh, approximately 1 m water).
9	"	2	Squeezings of Potamogeton pectinatus L.
10	23 July 1968	3	Sand and silt from 3-8 cm water (shaken up and decanted to remove coarse sand).
11	"	3	Squeezings of Vallisneria americana Michx.
12	"	3	Scrapings from culms of Scirpus validus Vahl., 60-90 cm water.
13	"	4	Rock scrapings, 15-45 cm water.
16	"	6	Cladophora sp. on rocks, 30-45 cm water.
17	"	6	Scrapings from dock pilings.
19	"	6	Turfy mat of diatoms on rocks, 61 cm water.
21	"	8	Scrapings from boulders in splash zone.
22	"	8	Scrapings from boulders below splash zone.
24	"	8	Scrapings from rocks, 90 cm water.
25	"	9	Sediment from shallow pool somewhat protected from wave action by rocks.
26	"	I	Surface plankton tow (#25 mesh, 60 cm water).
27	"	I	Squeezings of Najas sp., 15-30 cm water.
29	22 Nov. 1968	7	Filamentous diatoms attached to a piece of fine steel cable, 30 cm water.
31	"	7	Mat of diatoms caught between ripples of sand on bottom, 30 cm water.
35	23 Nov. 1968	10	Diatom growth on tin can, 30 cm water.
36	"	10	Cladophora etc. from submersed twigs, 7-8 cm water.
39	"	10	Scrapings from dock pilings from water surface to 30 cm below water surface.
42	"	8	Rock scrapings from splash zone.
43	"	8	Boulder scraping from surface to 30 cm below water surface.
44	"	8	Rock scrapings, 90 cm water.

Table 1. (Continued)

Sample Number	Collection Date	Sta. No.	
45	23 Nov. 1968	8	Flocculent sediment pipetted from pool protected by rocks and boulders, 2.5 cm water.
46	"	11	Scrapings from culms of Scirpus acutus Muhl., 60 cm water.
47	"	11	Squeezings of Potamogeton richardsonii (Benn.) Rydb., 45 cm water.
48	"	11	Damp sand from shoreline just above wave splash zone.
49	"	12	Squeezings of Potamogeton nodosus Poir., 15 cm water.
50	"	12	Spirogyra sp. on splash zone of rocks.
51	"	12	Squeezings of Elodea sp., 15 cm water.
53	"	12	Flocculent sediment and algae, 15 cm water.
54	"	I	Squeezings of Potamogeton pectinatus L., 30 cm water.
56	"	I	Surface plankton tow (#25 mesh, 30-60 cm water).
57	"	2	Rock scrapings, 7-8 cm water.
58	"	2	Squeezings of Myriophyllum sp., 30 cm water.
59	"	2	Scrapings from stems of Typha latifolia L., water surface to 60 cm below surface.
66	6 March 1969	3	Surface sediment collected by gently bouncing Van Dorn bottle on bottom in 1.1 m water (including 60 cm ice, 15 cm snow cover).
67	"	2	Scrapings of culms of Scirpus validus Vahl. from bottom of ice to lake bottom (53 cm water below 38 cm ice, 15 cm snow cover).
68	"	2	Scrapings of culms of Scirpus validus Vahl. from bottom of ice to top of ice (see previous sample).
70	"	2	Surface sediment collected by gently bouncing Van Dorn bottle on bottom (see sample #67).
71	"	8	Rock scrapings, 56 cm water (including 10 cm ice, 2.5 cm snow cover).
72	"	8	Rock scrapings, 60 cm water (including 11 cm ice, 7 cm snow cover).
78	"	13	Surface sediment collected by gently bouncing Van Dorn bottle on bottom in 3.7 m water (including 61 cm ice, 28 cm snow cover).
80	7 March 1969	12a	Surface sediment collected by gently bouncing Van Dorn bottle on bottom in 1.5 m water (including 61 cm ice, 13 cm snow cover).
84	"	14	Surface sediment collected by gently bouncing Van Dorn bottle on bottom in 4.0 m water (including 61 cm ice, 15 cm snow cover).
86	24 June 1969	11	Squeezings of Chara sp., 90 cm water.

Table 1. (Continued)

Sample Number	Collection Date	Sta. No.	
88	24 June 1969	11	Squeezings of Cladophora sp., 15 cm water.
89	"	11	Rock scrapings, 30 cm water.
90	"	10	Scrapings from dock pilings.
92	"	10	Squeezings of the submersed portion of a burlap bag hanging in the water.
93	"	1-7	Long surface plankton tow across lake between stations #1 and #7 (#2 mesh).
96	"	II	Squeezings of Potamogeton sp., 50 cm water.
112	7 July 1969	15	Cladophora sp. on rocks, 30 cm water.
113	"	15	Rock scrapings, 60 cm water.
115	"	15	Scrapings from the tanks of a pontoon boat.
116	"	III	Scrapings from broken pieces of clay tile on bottom of drainage ditch, 75 cm water.
117	"	III	Squeezings of grasses along margin of drainage ditch, 7-8 cm water.
118	"	IV	Surface sediments from drainage ditch, 15 cm water.
119	"	IV	Squeezings of grasses along margin of drainage ditch, 7-8 cm water.
120	"	V	Miscellaneous plant squeezings (45 m out into marsh from mouth of drainage ditch--see map).
121	"	VI	Squeezings of Sagittaria sp. stems, 90 cm water.
124	8 July 1969	II	Squeezings of Potamogeton sp.
125	"	II	Mixed plant squeezings.
126	"	II	Squeezings of Rhizoclonium sp., 1 m water.
130	23 June 1969	1-7	Long surface plankton tow across lake between stations #1 and #7 (samples taken with both #10 and #25 mesh nets, mixed and washed through 53 μ U.S. standard sieve to remove small diatoms).
131	21 July 1969	VII	Squeezings of Potamogeton sp., 45 cm water.
132	"	VII	Surface sediment pipetted from between plants, 30 cm water.
133	"	VII	Squeezings of Ceratophyllum demersum L., 45 cm water.
134	"	IX	Squeezings of Sagittaria sp. and Scirpus sp.
135	"	IX	Squeezings of Lemna minor L. and Spirodela polyrhiza (L.) Schleid.
136	"	IX	Squeezings of Spartina sp. which had fallen and was lying in 2-7 cm water.
137	"	IX	Surface sediment, 45 cm water.
138	"	IX	Algae and debris from bottom, 30 cm water.
139	"	VIII	Scrapings from dock pilings, water surface to 15 cm below surface.
142	22 July 1969	8	Rock scrapings, 15 cm water.
153	4 Aug. 1969	8	Rock scrapings, 15 cm water.

Table 1. (Continued)

Sample Number	Collection Date	Sta. No.	
154	4 Aug. 1969	8	Squeezings of Potamogeton nodosus Poir., 60 cm water.
155	"	8	Squeezings of Zannichellia palustris L., 60 cm water.
156	"	8	Squeezings of Heteranthera dubia (Jacq.) MacM., 30 cm water.
157	"	8a	Mixed filamentous algae (primarily Zygnema sp., Spirogyra sp., Rhizoclonium sp. and Oedogonium sp.), marshy area on south shore of the Island, 15-30 cm water.
158	"	8	Tufts of diatoms on splash zone of rocks.
159	"	8	Scrapings of Salix sp. stems, 30 cm water.
160	"	18	Scrapings from old tires on public dock.
161	"	VI	Surface sediment, 60 cm water.
162	"	VI	Squeezings of floating Lemna trisulca L. and Lemna minor L.
163	"	I	Scrapings of a very thin, prostrate green algal crust on the stems of Typha latifolia L., 15 cm water.
164	"	I	Surface sediment, 13-15 cm water.
172	18 Aug. 1969	8	Surface plankton tow (#25 mesh).
173	"	5	Surface plankton tow (#25 mesh).
179	15 Sept. 1969	8	Rock scrapings, just below water surface.
185	29 Sept. 1969	I	Surface sediment, 15 cm water.
198	27 Oct. 1969	XI	Surface sediment, 90 cm water.
215	10 Nov. 1969	8	Rock scrapings, 30 cm water.
226	6 Jan. 1970	8	Rock scrapings, 45 cm water (including 10 cm ice, 10 cm snow cover).
238	17 Feb. 1970	8	Rock scrapings, 30 cm water (under approximately 4 cm ice, 2.5 cm wet snow).
246	17 March 1970	8	Rock scrapings, 1 m water.
249	"	8	Rock scrapings, 30 cm water.
253	15 April 1970	8a	Rock scrapings, 30 cm water.
255	"	9	Diatom growth on Salix sp. roots extending into 25-30 cm water.
256	"	8	Rock scrapings, 30 cm water.
258	"	I	Scrapings from a plank submersed in 2-5 cm water.
261	"	I	Squeezings of dead Typha latifolia L. lying in 15 cm water.
262	29 April 1970	X	Silt collected by pulling #25 mesh plankton net through area disturbed by wave action.
263	"	8a	Rock scrapings, approximately 30 cm water.
267	"	X	Surface plankton tow (#25 mesh).
268	"	8	Rock scrapings, 18 cm water.

Table 1. (Continued)

Sample Number	Collection Date	Sta. No.	
278	13 May 1970	XII	Squeezings of Drepanocladus aduncus (Hedw.) Warnst., 60 cm water.
279	"	XII	Squeezings of grasses, approximately 15 cm water (this area is probably submersed only part of the year).
280	"	XII	Surface sediment, 60 cm water.
281	"	XIII	Scrapings from a floating plank.
282	"	XIII	Surface sediment, 60 cm water.
283	"	XIV	Squeezings from dead and decaying Typha latifolia L. and Scirpus sp.
284	"	XIV	Surface sediment, 60 cm water.
292	10 June 1970	X	Surface plankton tow (#25 mesh).
294	"	8	Rock scrapings, approximately 30 cm water.
302	24 June 1970	8	Rock scrapings, 30-40 cm water.
303	"	16	Rock scrapings, 15-30 cm water.
304	"	16	Squeezings of Cladophora sp., 15 cm water.
305	"	17	Scrapings, wall of dam at outlet of lake.
306	"	17a	Diatom growth coating culms of Eleocharis sp., 5-15 cm water in outlet stream (approximately 20 m below dam).
307	"	X	Squeezings of floating algal mat.
308	"	VI	Squeezings of Utricularia vulgaris L. floating at surface.
321	22 July 1970	X	Squeezings of Potamogeton pectinatus L. leaves floating near surface.
322	"	X	Squeezings of Nymphaea tuberosa Paine stems, 60 cm water.
324	"	8	Surface sediment, 1.8 m water, collected with a turkey baster (using scuba gear).
325	"	8	Surface sediment, 3.0 m water, collected with a turkey baster (using scuba gear).
326	"	8	Rock scraping, 2.1 m water.
332	-	-	Composite of all Aufwuchs and surface sediment samples collected from Ventura Marsh.
333	-	-	Composite of all Aufwuchs and surface sediment samples collected from Clear Lake.

Aufwuchs, sediment and qualitative plankton samples

The Aufwuchs samples include collections from filamentous algae, aquatic phanerogams, wood, rocks and a variety of miscellaneous substrates. Filamentous algae were collected in their entirety or large masses of them were hand squeezed over a collecting bottle in an effort to obtain the epiphytic diatoms. Aquatic phanerogams were stripped of their diatoms either by hand squeezing large masses of them over a collecting bottle or by scraping their surfaces with the edge of a pocket knife. The scraping technique was always employed when particular surfaces of a plant were examined, for example the underside of the leaves of *Nuphar* spp. Diatom growths on wood and rock substrates were collected either by scraping the surfaces with a pocket knife or, in the case of easily detached macroscopic growths, by the use of blunt-nosed forceps.

In shallow water, surface sediment samples were collected with small pipettes. Samples from deeper water were obtained by carefully lowering a Van Dorn bottle (over the side of a boat or through the ice) to the bottom, letting it settle onto its side, and disturbing the surface sediment by gently raising and lowering one end of the bottle before closing the instrument. A few of the deep water samples were procured by the use of scuba gear which permitted me to collect more precisely the uppermost layer of the sediment. A few epilithic samples were also collected in this manner.

Qualitative plankton samples, intended for use primarily in the taxonomic portion of the research, were collected by simply towing a plankton net a few centimeters below the water surface until the sample was sufficiently concentrated.

Each of the above samples was divided into two aliquots. One aliquot was preserved in Transeau's solution (a mixture of 6 parts water, 3 parts 95% alcohol, and 1 part commercial formalin) and set aside to determine whether the frustules were empty or contained protoplasts and to determine their colonial habit, if any. This aliquot was also useful for the examination of algae other than diatoms. The second aliquot was cleaned and a portion of it used to prepare permanent slides as described below.

Quantitative plankton samples

In an effort to monitor population changes of the planktonic diatoms, one lake station (number 8) and one marsh station (number X) were selected for sampling at 2-week intervals. Quantitative samples were collected by holding a 1-liter polyethylene bottle a few centimeters below the water surface until full and pouring the contents through a 25-mesh plankton net. The volume of water concentrated in this manner varied from 6 to 25 liters depending on the density of the plankton. The samples were preserved immediately in Transeau's solution.

Cleaning, Slide Preparation and Photography

The taxonomy of diatoms is based almost exclusively on the sculpturing of their siliceous walls or frustules. In order that critical observations of these features be made it is necessary that they be "cleaned" (i.e., the organic portions of the cell be removed) and mounted in a medium of high refractive index. The *Aufwuchs*, sediment, and qualitative plankton samples were cleaned by the hydrogen peroxide method of A. van der Werff (1955) and were mounted in Hyrax (R.I. 1.71) (personal communication, Custom Research and Development, Richmond, California). However, the peroxide method is too rigorous for very fragile diatoms like *Rhizosolenia eriensis*. For such forms, "burned mounts" are required. I used a technique which is a modification of the one presented by Patrick and Reimer (1966). I simply placed a small amount of the material on a coverslip, allowed it to dry, and placed the coverslip (specimen side up) on a hot plate set at approximately 500C until the protoplasts were completely oxidized. The normal procedure of mounting in Hyrax was then followed.

The quantitative plankton samples were also prepared by a burning method. Each sample was made up to a volume of 35 ml and shaken vigorously for several minutes. A 1.00 ml portion was withdrawn with a pipette and placed on a 22-mm square coverslip and allowed to air dry. This procedure was repeated until a sufficient number of valves were present on the coverslip to permit a useful count. In a few instances it was necessary to dilute the sample so that an accurate count could be made. The coverslip was then burned and a Hyrax mount prepared.

All specimens were examined with a Leitz Laborlux microscope equipped with a 1.32 N.A. fluorite-objective (95X), a 1.00 N.A. fluorite-objective (40X oil), and a 1.25 N.A. oil immersion condenser. Photographs were taken with a Nikon F camera using Panatomic-X film.

Specimen Preparation for Integrated Light and Electron Microscopy

Occasionally I, like many diatomists, found it desirable to examine and photograph particularly small or otherwise troublesome diatoms with the transmission electron microscope (TEM). I felt that it would be even more instructive, however, if I could observe the same frustules with both the TEM and the light microscope. To accomplish this, I developed and utilized the technique discussed below.

Copper grids (3 mm dia., 150-200 mesh) were coated with a 0.5% Formvar film (0.2, 1.0 and 2.0% films were also tested, but the 0.5% film proved to be optimal when both durability of the film and resolution were considered). A drop of a dilute suspension of peroxide-cleaned frustules was pipetted onto each grid and allowed to air dry. Peroxide cleaning tended to produce more single valves than other cleaning techniques and was, therefore, the preferred technique for TEM work. Once the grids had dried, the specimens were observed and photographed with an RCA (model EMU-3F) electron microscope. The grids were then carefully removed from the TEM specimen holder to prevent bending (the films of stressed grids fractured easily during the next steps of this procedure). A drop of Hyrax was placed on each of a number of microscope slides (one slide per grid) and the grids were set, specimen side down,[1]

[1]When the valves are placed on the grids, they usually settle with the valve surface against the Formvar film. When examining diatom valves with the light microscope, it is desirable that the valve surfaces be directed upward (toward the coverslip). In order to achieve this orientation, the grids must be placed on the slides with their specimen side down.

on the Hyrax drops. The slides were then placed on a hot plate pre-heated to 250 C and coverslips were immediately added. The Hyrax began bubbling within a few seconds and it was sometimes necessary to move the coverslips in order to keep them over the grids. The bubbling subsided within a few seconds (when the solvent had been driven off). The slides were quickly removed from the hot plate and the coverslips pressed down gently to remove any remaining bubbles. The slides were then allowed to cool, after which the specimens were examined with the light microscope. An apparently similar technique was employed by Gerloff (1970), though no details of the technique were presented.

It should be noted that the technique described above offered not only the opportunity to examine the same frustules with both the TEM and the light microscope, but also permitted me to use TEM micrographs for the preparation of line drawings which are accurate and meaningful to the light microscopist. That is, I was able to trace the TEM micrographs while omitting those details of the frustule which I could not resolve with the light microscope.

Counting Techniques

In order to determine the proportional representation of the major diatom components of the <u>Aufwuchs</u> and surface sediment samples, approximately 300 valves were identified and counted from each sample. These counts were made for each sample by selecting a random starting point on a permanent slide and identifying every valve until a total of 300 valves had been enumerated. Additionally, slides from every sample were scanned for rare species.

Many of the planktonic diatoms were colonial, some forming aggregates of several hundred cells. Because the plankton slides were prepared by the burning technique which does not separate the colonies into individual frustules, it was found that 1000 valves had to be counted from each sample to obtain reproducible results. A starting point along the right or left edge of the coverslip was selected at random and the slide was traversed until 1000 valves had been enumerated. If more than one complete transect was necessary, starting points for new transects were randomly selected. The area of the coverslip counted was recorded and the density (i.e., cells/liter raw sample) of all diatoms, or particular taxa, was calculated according to the following formula:

$$\text{Density} = \begin{array}{c}\text{Number}\\\text{cells}\\\text{counted}\end{array} \times \frac{\text{Area of coverslip}}{\text{Area counted}} \times \frac{\text{Total volume concentrated sample}}{\text{Volume of subsample on slide}} \times \frac{1}{\text{Original total volume of raw sample}}$$

A diatom cell wall or frustule consists of two valves which frequently become separated in the cleaning process. Furthermore, the valves of some taxa have a greater propensity to separate than those of others. To avoid the error introduced by this phenomenon, I counted individual valves, whether separated or not. It was necessary, therefore, to divide the number of valves by two in order to determine the number of cells counted.

The qualitative plankton samples were not subjected to counting, but were carefully examined to obtain a record of all taxa present, including rare forms not found in the quantitative counts.

In an effort to compare the structure of the diatom communities of the lake and the marsh, I utilized the truncated log-normal distribution techniques outlined by Preston (1948) and modified for diatom population studies by Patrick, Hohn, and Wallace (1954). Two composite samples containing subsamples from all the Aufwuchs and surface sediment samples collected from Clear Lake and Ventura Marsh, respectively, were prepared. A sufficient number of diatoms were counted from each of these samples to construct comparable truncated log-normal curves (i.e., curves with the height of the mode exposed and placed within the span of one interval). The number of diatoms identified and counted to establish the curves was 7,004 for Clear Lake and 6,165 for Ventura Marsh.

Chemical and Physical Measurements

A number of chemical and physical parameters were monitored biweekly at the two plankton stations (lake station 8 and marsh station X) during the period of 22 July 1969 to 8 July 1970. Additionally, nitrate and orthophosphate levels were measured for two drainage ditches leading into the marsh (stations III and IV) on 7 July 1969. Water samples were collected by holding a 1-liter polyethylene bottle several centimeters below the water surface. The following parameters were measured with a Hach Portable Engineer's Laboratory Kit (Hach Chemical Co., Ames, Iowa) as outlined in Catalog Number 10: ammonium nitrogen (nesslerization method); nitrate nitrogen (diazotization method using sulfanilic acid with naphthylamine hydrochloride); nitrate nitrogen (cadmium reduction method using 1-naphthylamine-sulfanilic acid); phenolphthalein alkalinity; methyl orange alkalinity; total hardness (titrimetric method using EDTA); orthophosphate (stannous chloride method); silica (silicomolybdate method); iron (phenanthroline method); chloride (Mohr method); sulfate (barium sulfate turbidimetric method).

Turbidity was measured with a Hellige Turbidimeter and temperature was determined using a mercury thermometer. Hydrogen-ion concentration was measured occasionally with a Beckman Zeromatic II pH meter. Conductivity measurements were made at lake stations 8, 16 and 17 and marsh stations VI and X on 24 June 1970 using a conductivity bridge (Yellow Springs Instrument Co., Model 31).

RESULTS

Chemical and Physical Data

Biweekly samples

A number of physical and chemical parameters were monitored every two weeks at Clear Lake station 8 and Ventura Marsh station X from 22 July 1969 to 8 July 1970. With the exception of nitrite nitrogen and ice and snow cover, the results are presented graphically in Figures 2 and 3.

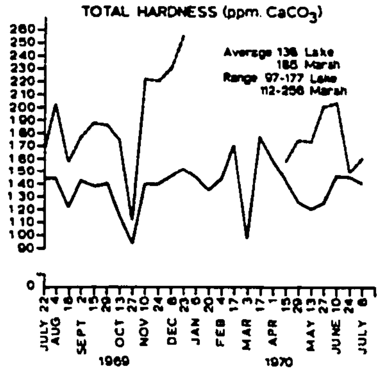
No nitrite nitrogen could be detected in the majority of the samples collected at lake station 8, but trace amounts were recorded for samples collected on the following dates: 4 August 1969, 29 September 1969, 6 January 1970, 20 January 1970, 4 February 1970, 1 April 1970, 29 April 1970, and 13 May 1970. No nitrite nitrogen could be detected in eight of the samples collected at marsh station X; trace amounts were detected at this station on 22 July 1969, 4 August 1969, 2 September 1969, 13 October 1969, 15 April 1970, 24 June 1970, and 8 July 1970; measurable amounts were found at station X on 27 October 1969 (0.02 ppm), 8 December 1969 (0.01 ppm), 13 May 1970 (0.01 ppm), and 27 May 1970 (0.05 ppm).

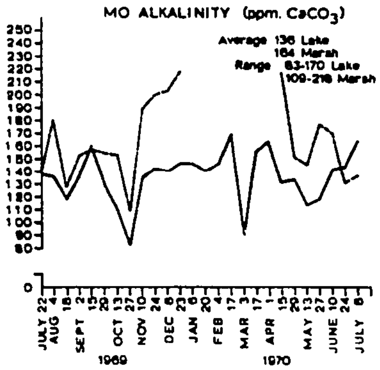
The amount of ice and snow cover encountered while collecting biweekly samples is summarized for both study areas in Table 2.

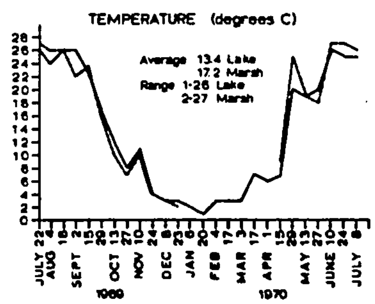
Sporadic samples

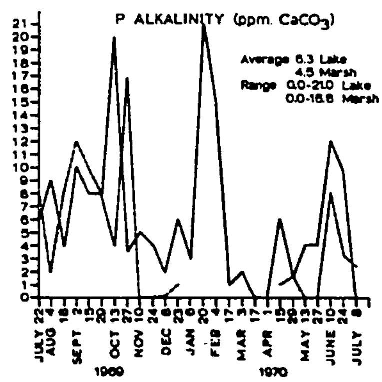
The physical and chemical parameters which were provided by the biweekly samples were augmented by the measurement of a few parameters at

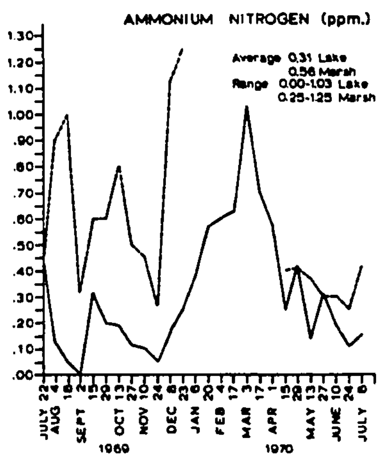
Figure 2. Biweekly analysis of water samples from Clear Lake (——) and Ventura Marsh (---) for total hardness, methyl orange alkalinity, ammonium nitrogen and nitrate nitrogen


TOTAL HARDNESS (ppm. CaCO3)
Average 136 Lake
186 Marsh
Range 97-177 Lake
112-256 Marsh
1969
1970


MO ALKALINITY (ppm. CaCO3)
Average 136 Lake
164 Marsh
Range 83-170 Lake
109-218 Marsh
1969
1970


TEMPERATURE (degrees C)
Average 13.4 Lake
17.2 Marsh
Range 1-26 Lake
2-27 Marsh
1969
1970


P ALKALINITY (ppm. CaCO3)
Average 6.3 Lake
4.5 Marsh
Range 0.0-21.0 Lake
0.0-16.6 Marsh
1969
1970


AMMONIUM NITROGEN (ppm.)
Average 0.31 Lake
0.56 Marsh
Range 0.00-1.03 Lake
0.25-1.25 Marsh
1969
1970

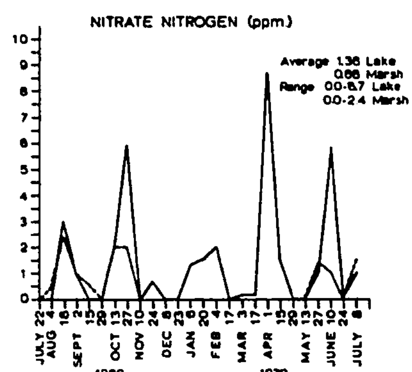
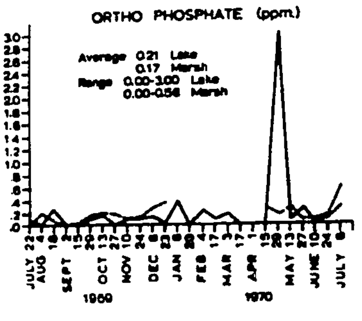
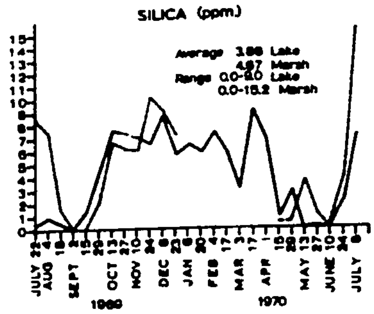
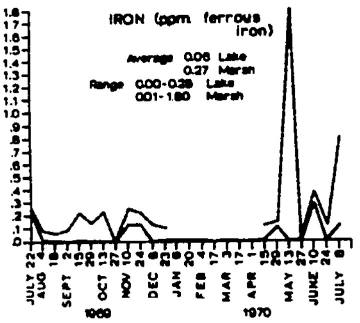
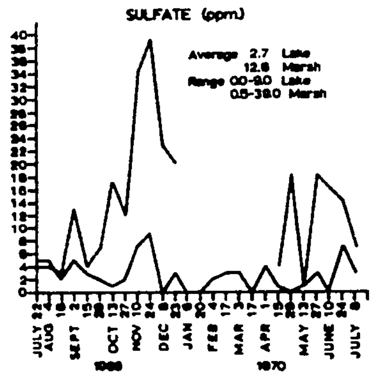

NITRATE NITROGEN (ppm.)
Average 1.36 Lake
0.66 Marsh
Range 0.0-8.7 Lake
0.0-2.4 Marsh
1969
1970

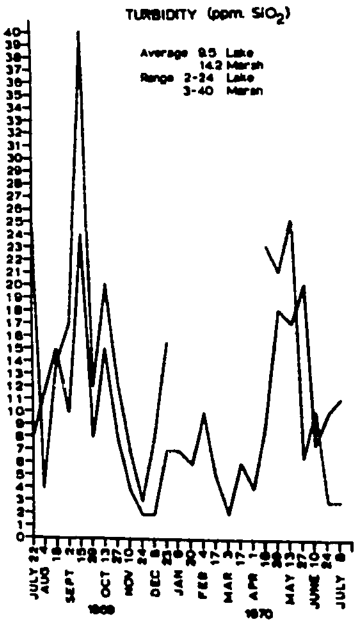
Figure 3. Biweekly analysis of water samples from Clear Lake (——) and Ventura Marsh (---) for orthophosphate, silica, iron, sulfate, turbidity, and chloride


ORTHO PHOSPHATE (ppm)
Average 0.21 Lake
0.17 Marsh
Range 0.00-3.00 Lake
0.00-0.56 Marsh
1969
1970


SILICA (ppm)
Average 3.88 Lake
4.87 Marsh
Range 0.0-9.0 Lake
0.0-15.2 Marsh
1969
1970


IRON (ppm ferrous iron)
Average 0.06 Lake
0.27 Marsh
Range 0.00-0.28 Lake
0.01-1.80 Marsh
1969
1970


SULFATE (ppm)
Average 2.7 Lake
12.6 Marsh
Range 0.0-9.0 Lake
0.5-38.0 Marsh
1969
1970


TURBIDITY (ppm SiO2)
Average 9.5 Lake
14.2 Marsh
Range 2-24 Lake
3-40 Marsh
1969
1970

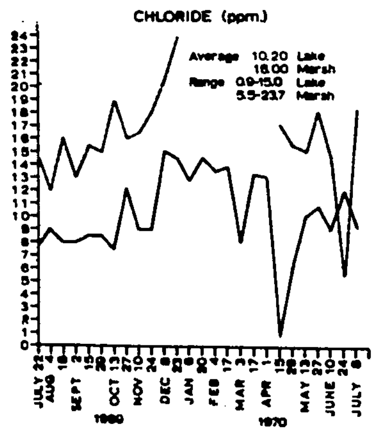

CHLORIDE (ppm)
Average 10.20 Lake
16.00 Marsh
Range 0.9-15.0 Lake
5.5-23.7 Marsh
1969
1970

Table 2. Thickness of ice and snow cover at Clear Lake station 8 and Ventura Marsh station X

	Clear Lake		Ventura Marsh	
Date	Ice Cover (cm)	Snow Cover (cm)	Ice Cover (cm)	Snow Cover (cm)
24 Nov. 1969	5	-	8	-
8 Dec. 1969	3	-*	8	31
23 Dec. 1969	8	30	20	31
6 Jan. 1970	15	15	25	10
20 Jan. 1970	30	30	no sample	
4 Feb. 1970	51	10	no sample	
17 Feb. 1970	51	13	no sample	
3 Mar. 1970	51	-	no sample	

*No snow cover at station but some snow elsewhere on lake.

irregular intervals and from stations not included in the biweekly sampling program.

The pH of nine Clear Lake samples collected at a number of stations in 1968 and 1969 varied from 8.0 to 9.0. The pH of nine Ventura Marsh samples collected at a number of stations in 1968 and 1969 varied from 7.2 to 9.6.

A series of conductivity measurements collected on 24 June 1970 yielded the following results: lake station 8, 300 micromhos; lake station 16, 285 micromhos; lake station 17, 300 micromhos; marsh station VI, 420 micromhos; marsh station X, 300 micromhos.

On 7 July 1969, water samples were collected from two drainage ditches emptying into Ventura Marsh (stations III and IV). Water from station III was found to contain 22.5 ppm nitrate nitrogen and 1.1 ppm orthophosphate; water from station IV was found to contain 41.0 ppm nitrate nitrogen and 0.20 ppm orthophosphate.

Taxonomy and Autecology

A total of 292 taxa (representing 36 genera) were encountered during the course of this study; 126 were common to both study areas while 98 taxa were observed only in Clear Lake and 68 only in Ventura Marsh. Clear Lake samples yielded 223 taxa from 35 genera; Ventura Marsh samples yielded 196 taxa from 28 genera. A systematic list (arranged according to the system of Hustedt, 1930) is presented in Table 3. The figures indicate the number of Clear Lake and Ventura Marsh samples in which each taxon occurred. Table 4 indicates the total number of taxa per genus as well as the number of taxa per genus for each of the two study areas.

The next section is an alphabetical listing of all the taxa and includes taxonomic and autecological information. For each taxon, a critical reference is given which contains the description and illustration which I used to make the final identification. The slide numbers refer to voucher slides which have been added to the Iowa State University diatom collection. The first digits of the slide numbers correspond to the sample numbers given in Table 1. The specimens which have been illustrated in this work are circled on these slides. The autecology includes my findings and, when pertinent, information from the literature. I have attempted to extract information from my data concerning (1) which of the two study areas each taxon preferred, (2) habitat preference, (3) seasonal periodicity, and (4) morphological variability of some of the more troublesome taxa. When appropriate, taxonomic considerations are also discussed.

With regard to my comments on abundance, the following terms and

Table 3. Systematic list of diatoms found in study area; figures indicate the number of Clear Lake and Ventura Marsh samples in which each taxon was found (a total of 117 Clear Lake samples and 65 Ventura Marsh samples were examined)

	Clear Lake	Ventura Marsh
Division Bacillariophyta		
Class Diatomatae		
Order Centrales		
Suborder Discineae		
Family Coscinodiscaceae		
Subfamily Melosiroideae		
Melosira ambigua var. ambigua	102	12
Melosira granulata var. granulata	81	3
Melosira granulata var. angustissima	10	28
Melosira italica var. italica	0	5
Melosira varians var. varians	3	0
Subfamily Coscinodiscoideae		
Cyclotella bodanica var. bodanica	4	0
Cyclotella comta var. comta	34	0
Cyclotella meneghiniana var. meneghiniana	5	24
Cyclotella stelligera var. stelligera	3	0
Stephanodiscus astraea var. minutula	16	31
Stephanodiscus invisitatus var. invisitatus	8	3
Stephanodiscus niagarae var. niagarae	39	5
Suborder Soleniineae		
Family Soleniaceae		
Subfamily Rhizosolenioideae		
Rhizosolenia eriensis var. eriensis	9	0
Order Pennales		
Suborder Araphidineae		
Family Fragilariaceae		
Subfamily Tabellarioideae		
Tabellaria sp.	1	0
Subfamily Meridionoideae		
Meridion circulare var. circulare	0	6
Diatoma vulgare var. vulgare	3	0
Subfamily Fragilarioideae		
Asterionella formosa var. formosa	48	4
Fragilaria brevistriata var. brevistriata	45	0
Fragilaria brevistriata var. inflata	1	0
Fragilaria brevistriata var. subcapitata	1	0
Fragilaria capucina var. capucina	59	22
Fragilaria capucina var. mesolepta	75	41
Fragilaria construens var. construens	38	1
Fragilaria construens var. venter	21	0
Fragilaria crotonensis var. crotonensis	94	9
Fragilaria crotonensis var. prolongata	22	0
Fragilaria pinnata var. lancettula	43	2

Table 3. (Continued)

	Clear Lake	Ventura Marsh
Fragilaria vaucheriae var. vaucheriae-------	80	34
Fragilaria vaucheriae var. capitellata------	8	4
Fragilaria virescens var. virescens---------	1	11
Opephora martyi var. martyi-----------------	12	0
Synedra acus var. acus----------------------	43	27
Synedra parasitica var. parasitica----------	3	0
Synedra rumpens var. familiaris-------------	0	1
Synedra rumpens var. fragilarioides---------	4	3
Synedra ulna var. ulna----------------------	1	18
Synedra ulna var. oxyrhynchus---------------	3	2
Synedra sp. #1------------------------------	0	1
Suborder Raphidioidineae		
Family Eunotiaceae		
Subfamily Eunotioideae		
Eunotia curvata var. curvata----------------	1	17
Eunotia formica var. formica----------------	1	5
Eunotia pectinalis var. minor---------------	1	1
Suborder Monoraphidineae		
Family Achnanthaceae		
Subfamily Achnanthoideae		
Achnanthes affinis var. affinis-------------	8	0
Achnanthes clevei var. clevei---------------	10	0
Achnanthes clevei var. rostrata-------------	14	0
Achnanthes exigua var. exigua---------------	5	1
Achnanthes exigua var. heterovalva----------	2	0
Achnanthes hungarica var. hungarica---------	0	21
Achnanthes lanceolata var. lanceolata-------	19	36
Achnanthes lanceolata var. dubia------------	12	1
Achnanthes lanceolata var. omissa-----------	2	0
Achnanthes lapponica var. ninckei-----------	11	0
Achnanthes minutissima var. minutissima-----	91	10
Rhoicosphenia curvata var. curvata----------	1	5
Subfamily Cocconeioideae		
Cocconeis pediculus var. pediculus----------	13	0
Cocconeis placentula var. placentula--------	26	10
Cocconeis placentula var. lineata-----------	26	44
Cocconeis sp. #1----------------------------	14	1
Cocconeis sp. #2----------------------------	15	0
Suborder Biraphidineae		
Family Naviculaceae		
Subfamily Naviculoideae		
Mastogloia grevillei var. grevillei---------	2	0
Amphipleura pellucida var. pellucida--------	40	0
Gyrosigma attenuatum var. attenuatum--------	3	0
Gyrosigma spencerii var. spencerii----------	2	0
Caloneis bacillaris var. thermalis----------	1	4

Table 3. (Continued)

	Clear Lake	Ventura Marsh
Caloneis bacillaris var. thermalis f.?------	0	1
Caloneis bacillum var. bacillum------------	7	3
Caloneis clevei var. uruguayensis----------	0	4
Caloneis lewisii var. lewisii--------------	0	2
Caloneis lewisii var. inflata--------------	0	2
Caloneis schumanniana var. schumanniana-----	0	1
Caloneis silicula var. silicula------------	1	1
Caloneis silicula var. truncatula----------	2	0
Neidium affine var. capitata---------------	0	2
Neidium affine var. tenuirostris-----------	0	1
Neidium affine var. undulatum--------------	0	2
Neidium bisulcatum var. baicalense----------	0	1
Neidium decens var. decens-----------------	0	1
Neidium distincte-punctatum var. distincte-punctatum----------	2	0
Neidium dubium var. dubium-----------------	1	0
Neidium hankensis var. hankensis-----------	1	4
Neidium hankensis var. elongata------------	0	3
Neidium hitchcockii var. hitchcockii--------	1	0
Neidium iridis var. iridis-----------------	2	1
Neidium iridis var. amphigomphus-----------	1	0
Neidium iridis var. amphigomphus f. rostrata-----------	0	1
Neidium temperei var. temperei-------------	1	1
Neidium sp. #2-----------------------------	1	0
Diploneis oculata var. oculata-------------	2	0
Diploneis ovalis var. ovalis---------------	0	2
Stauroneis acuta var. acuta----------------	1	1
Stauroneis anceps var. anceps--------------	0	2
Stauroneis phoenicenteron var. phoenicenteron------	3	0
Stauroneis phoenicenteron f. gracilis-------	1	0
Stauroneis phoenicenteron var. intermedia---	1	0
Stauroneis sp. #1--------------------------	0	1
Anomoeoneis sphaerophora var. sphaerophora--	0	2
Anomoeoneis sphaerophora var. sculpta-------	3	0
Anomoeoneis vitrea var. vitrea-------------	24	1
Navicula abiskoensis var. abiskoensis-------	2	4
Navicula abiskoensis f.?-------------------	0	1
Navicula accomoda var. accomoda------------	0	2
Navicula amphibola var. amphibola----------	0	2
Navicula anglica var. anglica--------------	2	0
Navicula aurora var. aurora----------------	2	0
Navicula bacillum var. bacillum------------	3	0
Navicula biconica var. biconica------------	0	3
Navicula bryophila var. bryophila----------	7	2

Table 3. (Continued)

	Clear Lake	Ventura Marsh
Navicula capitata var. capitata------------	3	17
Navicula capitata var. hungarica-----------	7	19
Navicula cincta var. rostrata--------------	2	17
Navicula confervacea var. confervacea-------	0	2
Navicula contenta f. parallela-------------	0	2
Navicula cryptocephala var. cryptocephala---	19	24
Navicula cryptocephala f. minuta-----------	66	0
Navicula cryptocephala var. veneta---------	39	1
Navicula cuspidata var. cuspidata----------	2	10
Navicula cuspidata var. heribaudii---------	1	0
Navicula cuspidata var. major--------------	0	1
Navicula decussis var. decussis------------	8	0
Navicula dicephala var. dicephala----------	1	1
Navicula dicephala var. rostrata-----------	0	2
Navicula disjuncta var. disjuncta----------	0	1
Navicula elata var. elata------------------	1	0
Navicula explanata var. explanata----------	3	0
Navicula graciloides var. graciloides-------	1	0
Navicula heufleri var. heufleri------------	1	12
Navicula lanceolata var. lanceolata---------	17	21
Navicula luzonensis var. luzonensis---------	2	14
Navicula menisculus var. obtusa------------	7	1
Navicula menisculus var. upsaliensis--------	4	1
Navicula minima var. minima----------------	1	0
Navicula mutica var. mutica----------------	1	6
Navicula mutica var. undulata--------------	0	1
Navicula mutica var.?---------------------	0	1
Navicula nigrii var. nigrii----------------	7	28
Navicula nyassensis f. minor---------------	1	1
Navicula oblonga var. oblonga--------------	1	0
Navicula paludosa var. paludosa------------	0	2
Navicula pelliculosa var. pelliculosa-------	0	1
Navicula peratomus var. peratomus----------	0	1
Navicula placentula var. placentula---------	3	1
Navicula placentula var. rostrata----------	0	1
Navicula platycephala var. platycephala-----	1	0
Navicula pseudatomus var. pseudatomus-------	0	6
Navicula pupula var. pupula----------------	3	11
Navicula pupula var. rectangularis---------	2	11
Navicula pupula var.?---------------------	3	0
Navicula radiosa var. radiosa--------------	31	0
Navicula radiosa var. parva----------------	2	0
Navicula radiosa var. tenella--------------	66	11
Navicula reinhardtii var. reinhardtii-------	5	1
Navicula salinarum var. intermedia---------	50	4
Navicula schoenfeldi var. schoenfeldi-------	10	0

Table 3. (Continued)

	Clear Lake	Ventura Marsh
Navicula seminulum var. seminulum----------	6	9
Navicula simplex var. simplex--------------	0	1
Navicula stroesei var. stroesei------------	2	0
Navicula subarvensoides var. subarvensoides-	0	6
Navicula subrotundata var. subrotundata-----	3	0
Navicula tantula var. tantula--------------	2	8
Navicula tripunctata var. tripunctata-------	3	1
Navicula tuscula var. tuscula--------------	2	0
Navicula tuscula f. minor------------------	4	0
Navicula vanheurckii var. vanheurckii-------	6	0
Navicula viridula var. argunensis----------	12	25
Navicula vulpina var. vulpina--------------	1	0
Navicula wittrockii var. wittrockii---------	1	5
Navicula sp. #16--------------------------	1	0
Pinnularia acrosphaeria var. acrosphaeria---	0	3
Pinnularia biceps var. biceps--------------	0	1
Pinnularia borealis var. borealis----------	1	0
Pinnularia brebissonii var. brebissonii-----	2	9
Pinnularia brebissonii f. biundulata--------	0	1
Pinnularia brevicostata var. brevicostata---	1	0
Pinnularia kneuckeri var. kneuckeri---------	0	3
Pinnularia nodosa var. nodosa--------------	0	2
Pinnularia ruttneri var. ruttneri----------	1	0
Pinnularia substomatophora var. substomatophora-----	0	1
Pinnularia viridis var. viridis------------	1	1
Pinnularia viridis var. intermedia---------	1	3
Pinnularia sp. #2-------------------------	1	2
Subfamily Amphiproroideae		
Amphiprora ornata var. ornata--------------	2	1
Tropidoneis lepidoptera var. proboscidea----	3	0
Subfamily Gomphocymbelloideae		
Gomphonema acuminatum var. acuminatum-------	0	1
Gomphonema acuminatum var. brebissonii------	1	3
Gomphonema acuminatum var. elongata---------	0	1
Gomphonema angustatum var. angustatum-------	1	10
Gomphonema angustatum var. sarcophagus------	0	3
Gomphonema carolinense var. carolinense-----	0	4
Gomphonema constrictum var. constrictum-----	1	7
Gomphonema constrictum var. capitatum------	0	3
Gomphonema constrictum f. parva------------	1	1
Gomphonema constrictum var. subcapitata-----	1	0
Gomphonema gracile var. aurita-------------	1	1
Gomphonema gracile var. lanceolata---------	9	5
Gomphonema gracile var. naviculoides-------	8	5
Gomphonema gracile var.?------------------	7	4

Table 3. (Continued)

	Clear Lake	Ventura Marsh
Gomphonema insigne var. insigne------------	1	5
Gomphonema insigne var. elongatum----------	1	2
Gomphonema intricatum var. intricatum-------	1	1
Gomphonema intricatum var. pumila----------	13	1
Gomphonema intricatum var. vibrio----------	1	4
Gomphonema montanum var. subclavata---------	7	25
Gomphonema olivaceoides var. olivaceoides---	14	2
Gomphonema olivaceum var. olivaceum---------	43	3
Gomphonema parvulum var. parvulum----------	9	44
Gomphonema parvulum var. micropus----------	2	17
Gomphonema sphaerophorum var. sphaerophorum-	2	2
Gomphonema subclavatum var. subclavatum-----	1	1
Gomphonema subclavatum var. mexicanum-------	0	7
Gomphonema subtile var. subtile------------	1	0
Gomphonema tenellum var. tenellum----------	33	2
Gomphonema turris var. turris--------------	0	1
Amphora ovalis var. libyca-----------------	19	23
Amphora ovalis var. pediculus--------------	68	7
Amphora submontana var. submontana---------	1	5
Amphora veneta var. veneta-----------------	8	28
Cymbella affinis var. affinis--------------	28	0
Cymbella aspera var. aspera----------------	2	0
Cymbella caespitosum var. caespitosum-------	67	1
Cymbella cistula var. cistula--------------	12	0
Cymbella cuspidata var. cuspidata----------	3	0
Cymbella hustedtii var. hustedtii----------	5	0
Cymbella hybrida var. hybrida--------------	1	0
Cymbella inaequalis var. inaequalis---------	2	0
Cymbella microcephala var. microcephala-----	70	1
Cymbella obtusiuscula var. obtusiuscula-----	1	0
Cymbella prostrata var. prostrata----------	5	0
Cymbella ruttneri var. obtusa--------------	1	0
Cymbella schweickerdtii var. schweickerdtii------	3	0
Cymbella sinuata var. sinuata--------------	1	0
Cymbella triangulum var. triangulum---------	1	0
Cymbella turgida var. pseudogracilis--------	38	5
Cymbella ventricosa var. splendens----------	0	1
Cymbella sp. #6---------------------------	14	0
Cymbella sp. #7---------------------------	10	0
Cymbella sp. #8---------------------------	2	0
Family Epithemiaceae		
Subfamily Epithemioideae		
Epithemia sorex var. sorex-----------------	3	0
Epithemia turgida var. turgida-------------	2	7
Epithemia zebra var. saxonica--------------	12	13

Table 3. (Continued)

	Clear Lake	Ventura Marsh
Subfamily Rhopalodioideae		
Rhopalodia gibba var. gibba	13	13
Family Nitzschiaceae		
Subfamily Nitzschioideae		
Hantzschia amphioxys var. amphioxys	2	5
Hantzschia amphioxys var. maior	0	1
Hantzschia amphioxys var. vivax	0	1
Nitzschia acicularioides var. acicularioides	3	1
Nitzschia acicularis var. acicularis	7	8
Nitzschia acuta var. acuta	3	0
Nitzschia amphibia var. amphibia	29	53
Nitzschia angustata var. angustata	7	3
Nitzschia angustata var. acuta	13	0
Nitzschia capitellata var. capitellata	5	9
Nitzschia commutata var. commutata	0	2
Nitzschia debilis var. debilis	0	1
Nitzschia dissipata var. dissipata	62	5
Nitzschia elegans var. elegans	5	3
Nitzschia fonticola var. fonticola	8	3
Nitzschia frustulum var. frustulum	0	11
Nitzschia gracilis var. gracilis	1	0
Nitzschia graciloides var. graciloides	4	0
Nitzschia holsatica var. holsatica	9	21
Nitzschia hungarica var. hungarica	0	3
Nitzschia lauenburgiana var. lauenburgiana	8	0
Nitzschia legleri var. legleri	3	1
Nitzschia linearis var. linearis	12	9
Nitzschia palea var. palea	8	25
Nitzschia palea var. debilis	4	6
Nitzschia palea var. tropica	0	1
Nitzschia paleoides var. paleoides	2	6
Nitzschia parvula var. terricola	0	1
Nitzschia philippinarum var. philippinarum	0	3
Nitzschia pilum var. pilum	6	7
Nitzschia recta var. recta	10	0
Nitzschia sigmoidea var. sigmoidea	1	0
Nitzschia subrostrata var. subrostrata	3	5
Nitzschia subrostratoides var. subrostratoides	0	1
Nitzschia subtilioides var. subtilioides	1	3
Nitzschia tenuis var. tenuis	3	0
Nitzschia tropica var. tropica	58	34
Nitzschia valdestriata var. valdestriata	2	0
Nitzschia sp. #4	2	2
Nitzschia sp. #12	0	3
Nitzschia sp. #13	0	6

Table 3. (Continued)

	Clear Lake	Ventura Marsh
Family Surirellaceae		
Subfamily Surirelloideae		
Cymatopleura cochlea var. cochlea----------	2	2
Cymatopleura solea var. solea--------------	1	3
Cymatopleura solea var. apiculata----------	0	1
Cymatopleura solea var. gracilis-----------	2	1
Surirella angusta var. angusta-------------	1	20
Surirella biseriata f. punctata------------	2	0
Surirella kittoni var. kittoni-------------	1	0
Surirella linearis var. constricta---------	1	0
Surirella linearis var. helvetica----------	1	0
Surirella ovata var. ovata-----------------	0	2
Surirella ovata var. pinnata---------------	0	5
Surirella robusta var. robusta-------------	1	0
Surirella tenera var. nervosa--------------	1	0

Table 4. List of genera found in study area showing the total number of taxa within each genus and the distribution of these taxa in Clear Lake and Ventura Marsh samples

Genus	Total Number of Taxa per Genus	Number of Taxa per Genus in Clear Lake	Number of Taxa per Genus in Ventura Marsh
Achnanthes	11	10	5
Amphipleura	1	1	0
Amphiprora	1	1	1
Amphora	4	4	4
Anomoeoneis	3	2	2
Asterionella	1	1	1
Caloneis	8	4	7
Cocconeis	5	5	3
Cyclotella	4	4	1
Cymatopleura	4	3	4
Cymbella	20	19	4
Diatoma	1	1	0
Diploneis	2	1	1
Epithemia	3	3	2
Eunotia	3	3	3
Fragilaria	13	13	8
Gomphonema	30	23	28
Gyrosigma	2	2	0
Hantzschia	3	1	3
Mastogloia	1	1	0
Melosira	5	4	4
Meridion	1	0	1
Navicula	69	50	46
Neidium	15	8	10
Nitzschia	38	28	31
Opephora	1	1	0
Pinnularia	13	6	10
Rhizosolenia	1	1	0
Rhoicosphenia	1	1	1
Rhopalodia	1	1	1
Stauroneis	6	4	3
Stephanodiscus	3	3	3
Surirella	9	7	3
Synedra	7	5	6
Tabellaria	1	1	0
Tropidoneis	1	1	0
Totals	292	223	196

definitions apply to all samples except the quantitative plankton samples:

Rare--occurring 1 to 5 times in a count of approximately 300 valves,

Uncommon--occurring 6 to 20 times in a count of approximately 300 valves,

Common--occurring 21 to 50 times in a count of approximately 300 valves,

Abundant--occurring 51 to 100 times in a count of approximately 300 valves,

Very abundant--occurring more than 100 times in a count of approximately 300 valves.

For quantitative plankton samples, the following apply:

Rare--occurring 1 to 5 times in a count of 1000 valves,

Uncommon--occurring 6 to 20 times in a count of 1000 valves,

Common--occurring 21 to 100 times in a count of 1000 valves,

Abundant--occurring 101 to 500 times in a count of 1000 valves,

Dominant--occurring more than 500 times in a count of 1000 valves.

Achnanthes Bory

Achnanthes *affinis* Grun. var *affinis* Pl. IV, Fig. 1, Slide #333-1.

Critical reference: Patrick and Reimer 1966, p. 254, Pl. 16, Fig. 11-12.

Found only in the lake (8 samples), but almost always rare and never common. No clear indication of habitat preference or periodicity.

Achnanthes clevei Grun. var. clevei Pl. IV, Fig. 18-19, Slide #215-2.

Critical reference: Patrick and Reimer 1966, p. 267, Pl. 17, Fig. 21-22.

Found only in the lake (10 samples). Rare in the surface sediments, on rocks and in the psammon. No clear indication of periodicity.

Achnanthes clevei var. rostrata Hust. Pl. IV, Fig. 20-21, Slide #89-1.

Critical reference: Patrick and Reimer 1966, p. 267, Pl. 17, Fig. 23-24.

Found only in the lake (14 samples). Rare in all samples except in surface sediments and psammon where it was uncommon. No clear indication of periodicity.

Achnanthes exigua Grun. var. exigua Pl. IV, Fig. 8-9, Slide #66-1.

Critical reference: Patrick and Reimer 1966, p. 257, Pl. 16, Fig. 21-22.

Rare in five lake samples and one marsh sample. No clear indication of either habitat preference or periodicity.

Achnanthes exigua var. heterovalva Krasske Pl. IV, Fig. 10-11, Slide #78-3.

Critical reference: Patrick and Reimer 1966, p. 258, Pl. 16, Fig. 25-26.

Found only in two lake sediment samples; rare at station 14 in 4.0 m water (including 61 cm ice covered with 15 cm snow) and uncommon at station 12a in 1.5 m water (including 61 cm ice covered with 13 cm snow).

Achnanthes hungarica (Grun.) Grun. var. hungarica Pl. IV, Fig. 14-15, Slide #135-1.

Critical reference: Patrick and Reimer 1966, p. 259, Pl. 16, Fig. 27-28.

Found only in the marsh where it appeared in 21 samples. Best development at station IX where it appeared abundantly on Sagittaria sp. and Scirpus sp. and very abundantly on Lemna minor and Spirodela polyrhiza. Hustedt (1930 and 1933), Cleve-Euler (1932) and Jørgensen (1948) have also reported this taxon to be abundant on Lemna spp. Rare to common in other samples. Best growth in July and August at which time the "host" plants were well developed.

Achnanthes lanceolata (Bréb.) Grun. var. lanceolata Pl. IV, Fig. 4-5, Slide #119-1.

Critical reference: Patrick and Reimer 1966, p. 269, Pl. 18, Fig. 1-10.

Found in 19 lake samples and 36 marsh samples. Rare to uncommon in the lake samples with its best development in surface sediments. In the marsh its best development (abundant to very abundant) was on grasses in the two drainage ditches (stations III and IV) and on a variety of plants at station V which is 45 m north of the mouth of one of these ditches. It should be noted that these ditches were very enriched at the time of collection (22.5 ppm nitrates and 1.1 ppm phosphates at station III; 41.0 ppm nitrates and 0.2 ppm phosphates at station IV). Rare to common in the other samples. No clear indication of periodicity.

Achnanthes lanceolata var. dubia Grun. Pl. IV, Fig. 6-7, Slide #324-1.

Critical reference: Patrick and Reimer 1966, p. 271, Pl. 18, Fig. 11-13.

Occurred in 12 lake samples and only one marsh sample. No clear indication of habitat preference in Clear Lake where it was rare to uncommon in the samples. Appeared during all seasons of the year except winter. Because the only marsh sample in which this taxon occurred was a composite, no comments can be made concerning its autecology there.

Achnanthes lanceolata var. omissa Reimer Pl. IV, Fig. 12-13, Slide #324-2.

Critical reference: Patrick and Reimer 1966, p. 272, Pl. 18, Fig. 16-17.

Found only in the lake and in only two samples, one of which was a composite. Uncommon in a surface sediment sample from 1.8 m water at station 8 (22 July 1970). I have been unable to find any ecological information from the literature. This is probably due, at least in part, to the fact that this taxon has only recently been described and is often confused with A. lanceolata var. elliptica P. T. Cleve.

Achnanthes lapponica var. ninckei (Guerm. & Mang.) Reimer Pl. IV, Fig. 16-17, Slide #226-1 (raphe valve) and #249-1 (pseudoraphe valve).

Critical reference: Patrick and Reimer 1966, p. 259, Pl. 16, Fig. 29-30.

Found only in the lake (11 samples) and always rare to uncommon. No clear indication of habitat preference or periodicity.

Achnanthes minutissima Kütz. var. minutissima Pl. IV, Fig. 2-3, Slide #44-1.

Critical reference: Patrick and Reimer 1966, p. 253, Pl. 16, Fig. 9-10.

Occurred in both the lake and the marsh. One of the most common diatoms of Clear Lake; found in 91 samples (including 94% of the non-plankton samples) in which it was often abundant to very abundant. Found in 10 marsh samples; rare to common in these samples. No clear indication of habitat selection or seasonal periodicity in either of the study areas.

<u>Amphipleura</u> Kütz.

<u>Amphipleura</u> <u>pellucida</u> Kütz. var. <u>pellucida</u> Pl. IV, Fig. 22, Slide #11-4.

Critical reference: Patrick and Reimer 1966, p. 303, Pl. 21, Fig. 2a-b.

Found only in the lake (40 samples). Appeared in a great variety of habitats, but was common only in a few epiphytic and epilithic samples; rare to uncommon in the other samples. Reached a frequency of common only during the period of mid-July to mid-September.

<u>Amphiprora</u> Ehr.

<u>Amphiprora</u> <u>ornata</u> Bailey var. <u>ornata</u> Pl. IV, Fig. 23, Slide #22-5.

Critical reference: Hustedt 1930, p. 340, Text fig. 626.

Rare in two lake samples and one marsh sample. In rock scrapings from lake station 8 (23 July 1968) and in the lake plankton at station 8 (27 May 1970). In the surface sediment in 30 cm water at marsh station VII (21 July 1969).

<u>Amphora</u> Ehr.

<u>Amphora</u> <u>ovalis</u> var. <u>libyca</u> (Ehr.) P. T. Cleve Pl. VIII, Fig. 4, Slide #185-1.

Critical reference: Schmidt 1875 in Schmidt et al. 1874-1959, Pl. 26, Fig. 104.

Found in 19 lake and 23 marsh samples. Rare to uncommon in these samples. No clear indication of either habitat preference or periodicity.

Amphora ovalis var. pediculus (Kütz.) Grun. in Van Heurck Pl. VIII, Fig. 2-3, Slide #17-1 and #11-2.

Critical reference: Hustedt 1930, p. 343, Text fig. 629.

Found in 68 lake samples and seven marsh samples. Rare to common in all samples except one--abundant in a rock scraping from 2.1 m water at station 8 (22 July 1970). Occurred during all seasons of the year and in a great variety of habitats.

Amphora submontana Hust. var. submontana Pl. XVIII, Fig. 10, Slide #136-1.

Critical reference: Hustedt 1949a, p. 112, Pl. 11, Fig. 4.

Rare to uncommon in five marsh samples and rare in one lake sample. Appears to be an epiphyte in the marsh (on a variety of plants); found in the surface sediment in 3-8 cm water at lake station 3 (23 July 1968). Observed only in May and July samples.

Amphora veneta (Kütz.) Hust. var. veneta Pl. VIII, Fig. 1, Slide #4-1.

Critical reference: Hustedt 1930, p. 345, Text fig. 631.

Found in eight lake and 28 marsh samples. No habitat preference or seasonal periodicity apparent. Rare to uncommon in the samples.

Anomoeoneis Pfitzer

Anomoeoneis sphaerophora (Ehr.) Pfitzer var. sphaerophora Pl. V,

Fig. 10, Slide #132-2.

Critical reference: Patrick and Reimer 1966, p. 374, Pl. 32, Fig. 1.

Found only in two marsh samples; rare in a composite sample and in the surface sediment from 30 cm water at station VII (21 July 1969).

Anomoeoneis sphaerophora var. sculpta O. Müller Pl. V, Fig. 11, Slide #304-1.

Critical reference: Patrick and Reimer 1966, p. 375, Pl. 32, Fig. 2.

Rare in three lake samples. In a surface sediment sample from 3.7 m water (including 61 cm ice covered with 28 cm snow) at station 13 (6 March 1969), an epilithic sample from station 8 (23 July 1968), and in a Cladophora sp. squeezing from station 16 (24 June 1970).

Anomoeoneis vitrea (Grun.) Ross var. vitrea Pl. V, Fig. 9 and Pl. XVIII, Fig. 12, Slide #11-4.

Critical reference: Patrick and Reimer 1966, p. 380, Pl. 33, Fig. 12-13.

Found in 24 lake samples and only one marsh sample. Best development (rare to common) as an epiphyte on a variety of plants and as an epilith in the lake; rare in the other lake samples. Collected from March to November from the lake, common only in November. A rare epiphyte on Najas sp. at marsh station I (23 July 1968).

Asterionella Hassall

Asterionella formosa Hassall var. formosa Pl. III, Fig. 2, Slide #130-5.

Critical reference: Patrick and Reimer 1966, p. 158, Pl. 9,

Fig. 1-3.

Found in 48 lake samples and four marsh samples. Occurred in a great variety of habitats, but its best development was in the plankton of Clear Lake where it was common to abundant from 3 March 1970 to 27 May 1970 with a maximum population on 13 May 1970 (8.8×10^5 cells/liter); rare to uncommon in the other lake samples. Because it was almost always rare in the surface sediments of the lake, its frustules must quickly dissolve once deposited there. Never a major contributor to the marsh plankton; common on 13 May 1970, rare in the other three samples.

The common appearance of this diatom in both oligotrophic and eutrophic waters (Kilham, 1971) has hindered the many attempts to define its autecology. The factors which determine its distribution remain a mystery.

Caloneis P. T. Cleve

Caloneis bacillaris var. *thermalis* (Grun.) A. Cleve Pl. VII, Fig. 1, Slide #284-1.

Critical reference: Patrick and Reimer 1966, p. 586, Pl. 54, Fig. 7.

Found in four marsh samples. An uncommon epiphyte on grasses at station XII (13 May 1970) and rare on *Ultricularia vulgaris* at station VI (24 June 1970). Rare in the surface sediments from 45 cm water at station IX (21 July 1969) and from 60 cm water at station XIV (13 May 1970).

Caloneis bacillaris var. *thermalis* (Grun.) A. Cleve f.? Pl. VII, Fig. 2, Slide #282-2.

Found in one marsh sample; in a sediment sample from 60 cm water at station XIII (13 May 1970).

The shape of the valve, the stria count, and the shape of the axial area indicate a very close relationship of this taxon to C. bacillaris var. thermalis from which it differs only in that it possesses a transverse fascia and is somewhat smaller. A thorough investigation of these two taxa may prove that they should be united.

Caloneis bacillum (Grun.) P. T. Cleve var. bacillum Pl. VII, Fig. 3, Slide #303-1.

Critical reference: Patrick and Reimer 1966, p. 586, Pl. 54, Fig. 8.

Found in seven lake samples and three marsh samples. Rare in these samples. No clear evidence of habitat preference. Observed from March to November.

Caloneis clevei var. uruguayensis Frenguelli Pl. VII, Fig. 4, Slide #132-9.

Critical reference: Frenguelli 1933, p. 130, Text fig. la-b.

Rare in three surface sediment samples from marsh stations VI, VII and XII (4 August 1969, 21 July 1969 and 13 May 1970 respectively) and in a scraping from a floating wooden plank from station XIII (13 May 1970). Because the surface sediments of the marsh are rich in plant detritus and because Frenguelli described this taxon from a sample of "detritus vegetales y minerals," it seems safe to assume that such sediments represent its preferred habitat.

To my knowledge, this is the first report of this taxon in United States waters and, indeed, one of the few reports of the taxon since it was described.

<u>Caloneis lewisii</u> Patr. var. <u>lewisii</u> Pl. VII, Fig. 5, Slide #137-2.

Critical reference: Patrick and Reimer 1966, p. 588, Pl. 54, Fig. 11.

Rare in the surface sediment from 45 cm water at marsh station IX (21 July 1969) and from 60 cm water at marsh station XIII (13 May 1970).

<u>Caloneis lewisii</u> var. <u>inflata</u> (Schulte) Patr. Pl. VII, Fig. 6, Slide #308-1.

Critical reference: Patrick and Reimer 1966, p. 589, Pl. 54, Fig. 12.

Rare in two marsh samples, a surface sediment sample from 60 cm water at station XII (13 May 1970) and in a squeezing of <u>Utricularia vulgaris</u> at station VI (24 June 1970).

<u>Caloneis schumanniana</u> (Grun.) P. T. Cleve var. <u>schumanniana</u> Pl. VII, Fig. 7, Slide #279-3.

Critical reference: Hustedt 1930, p. 239, Text fig. 369.

Found only in the marsh where it was a rare epiphyte on grasses in 15 cm water at station XII (13 May 1970).

<u>Caloneis silicula</u> (Ehr.) P. T. Cleve var. <u>silicula</u> Pl. VII, Fig. 8, Slide #39-3.

Critical reference: Hustedt 1930, p. 236, Text fig. 362.

Observed only in one marsh sample--rare in scrapings from dock pilings at station 10 (23 November 1968).

<u>Caloneis silicula</u> var. <u>truncatula</u> Grun. Pl. VII, Fig. 9, Slide #39-3.

Critical reference: Hustedt 1930, p. 238, Text fig. 363 and 364.

Rare in two Clear Lake samples; in a scraping from dock pilings at station 10 (23 November 1968) and in squeezings of Potamogeton pectinatus at station 2 (23 July 1968).

Cocconeis Ehr.

Cocconeis pediculus Ehr. var. pediculus Pl. III, Fig. 12 and 13, Slide #36-1.

Critical reference: Patrick and Reimer 1966, p. 240, Pl. 15, Fig. 3-4.

Found only in the lake (13 samples). Best development as an epiphyte; reached its highest frequency (uncommon) in only five samples all of which were squeezings of Cladophora sp. or Rhizoclonium sp., otherwise rare. Observed from April to November, but most frequent from late June to late November.

Cocconeis placentula Ehr. var. placentula Pl. III, Fig. 7 and 8, Slide #283-5 and #283-6 respectively.

Critical reference: Patrick and Reimer 1966, p. 240, Pl. 15, Fig. 7.

Observed in 26 lake samples and 10 marsh samples. Best development in both study areas as an epiphyte on a great variety of plants. Rare to common in Clear Lake samples; rare to abundant in Ventura Marsh samples. Found during all seasons.

Cocconeis placentula var. lineata (Ehr.) Van Heurck Pl. III, Fig. 9, Slide #133-1.

Critical reference: Patrick and Reimer 1966, p. 241, Pl. 15, Fig. 5-6.

Rare to very abundant in both the lake (26 samples) and the marsh (44 samples). Best development in both study areas as an epiphyte on a great variety of plants. Also encountered frequently in the surface sediment (rare to common) and in the plankton (rare to abundant) of the marsh, but I doubt that the frustules originated in either of these habitats. Observed during all months of the year.

Cocconeis sp. #1 Pl. III, Fig. 10, Slide #78-2.

Found in 14 lake samples and in one marsh sample. Rare to common in a variety of lake habitats, but no preference was apparent. Observed during all seasons in the lake. Rare in the marsh plankton at station 10 (8 December 1969).

Cocconeis sp. #2 Pl. III, Fig. 11, Slide #232-1.

Observed in 15 lake samples; not observed from the marsh. Found from a variety of habitats, but most often in sediment samples. Rare to uncommon and collected during all seasons.

Cyclotella Kütz.

Cyclotella bodanica Eulenstein var. bodanica Pl. I, Fig. 5, Slide #304-2.

Critical reference: Hustedt 1928, p. 356, Text fig. 184.

Rare in four lake samples. An epiphyte on Scirpus sp. at station 2 (22 July 1968), in the surface sediment from 1.8 m and 3.0 m water at station 8 (both 22 July 1970), and in scrapings of rocks from 30 cm water at station 8a (15 April 1970).

Cyclotella comta (Ehr.) Kütz. var. comta Pl. I, Fig. 4, Slide #304-2.

Critical reference: Hustedt 1928, p. 354, Text fig. 183.

Rare to uncommon in 34 lake samples. Appeared in a variety of habitats and exhibited no strong preference. Observed during all seasons.

<u>Cyclotella meneghiniana</u> Kütz. var. <u>meneghiniana</u> Pl. I, Fig. 6, Slide #132-1.

Critical reference: Hustedt 1928, p. 341, Text fig. 174.

Found in 24 marsh samples and five lake samples. Appeared in a variety of habitats in both study areas, but showed its best development in the marsh plankton where it was common in December, April and May. Rare to uncommon in the other samples. Observed during all seasons.

<u>Cyclotella stelligera</u> P. T. Cleve & Grun. var. <u>stelligera</u> Pl. I, Fig. 7 and 8, Slide #284-2 and #21-1 respectively.

Critical reference: Hustedt 1928, p. 339, Text fig. 172.

Rare in two lake samples and one marsh sample. In scrapings of rocks from splash zone at lake station 8 (22 July 1968), in the lake plankton at station 8 (23 December 1969), and in surface sediment from 60 cm water at marsh station XIV (13 May 1970).

<u>Cymatopleura</u> Wm. Smith nom. cons.

<u>Cymatopleura cochlea</u> Brun var. <u>cochlea</u> Pl. XVI, Fig. 11, Slide #130-1.

Critical reference: Fricke and Hustedt 1911 <u>in</u> Schmidt et al. 1874-1959, Pl. 276, Fig. 4-6.

Rare in two lake samples and two marsh samples. In a long surface plankton tow taken across the lake from station 1 to station 7 (23 June 1969) and in the plankton at station 8 (22 July 1969). In the marsh plankton at station X (18 August 1969) and in the surface sediment at station X (29 April 1970).

<u>Cymatopleura solea</u> (Bréb.) Wm. Smith var. <u>solea</u> Pl. XVI, Fig. 8, Slide #185-2.

Critical reference: Hustedt 1930, p. 425, Text fig. 823a.

Rare in three marsh samples and one lake sample. In the surface sediments from 30 cm water at marsh station VII (21 July 1969) and from 15 cm water at station I (29 September 1969); in the marsh plankton at station X (18 August 1969). Epiphytic on *Potamogeton pectinatus* at lake station 2 (22 July 1968).

Cymatopleura solea var. *apiculata* (Wm. Smith) Ralfs Pl. XVI, Fig. 9, Slide #332-1.

Critical reference: Hustedt 1930, p. 426, Text fig. 823c.

Rare in a composite sample from the marsh. Hustedt (1930) stated that this variety is especially frequent and typical in the plankton of north German lakes.

Cymatopleura solea var. *gracilis* Grun. Pl. XVI, Fig. 10, Slide #130-2.

Critical reference: Meister 1912, p. 218, Pl. 39, Fig. 3.

Rare in two lake samples and one marsh sample. In a long surface plankton tow taken across the lake from station 1 to 7 (23 June 1969), in the surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969), and in surface sediment from 30 cm water at marsh station VII (21 July 1969).

Cymbella Agardh

Cymbella affinis Kütz. var. *affinis* Pl. VIII, Fig. 16, Slide #306-1.

Critical reference: Hustedt 1930, p. 362, Text fig. 671a.

Found in 28 lake samples from a variety of habitats, but most frequently encountered on rock stubstrates. Rare to abundant in the samples. Best development from 10 November 1969 to 10 June 1970.

It should be noted that it was abundant only on 17 February 1970 (on rocks) when the lake was covered with ice and snow.

Cymbella aspera (Ehr.) Héribaud var. aspera Pl. IX, Fig. 5, Slide #10-1.

Critical reference: Hustedt 1930, p. 365, Text fig. 680.

Rare in three lake samples. In the surface sediment from 3-8 cm water at station 3 (23 July 1968), and in scrapings of rocks just below the water surface (15 September 1969) and in 2.1 m water (22 July 1970) from station 8.

Cymbella caespitosum (Kütz.) Brun var. caespitosum Pl. VIII, Fig. 9-13, Slide #87-3, #86-5, #22-2, and #86-5 respectively.

Critical reference: Brun 1880, p. 56, Pl. 3, Fig. 16.

Found in 67 lake samples and only one marsh sample. One of the most common diatoms in the lake; observed on a great variety of substrates and occasionally in the plankton. Abundant to very abundant in July and rare to common at other times of the year. Uncommon in the marsh plankton at station X (8 July 1970).

Because this taxon is extremely variable in shape, I have illustrated several frustules. Dr. Reimer (personal communication) feels that this diatom should be considered a variety of Cymbella prostrata and will probably make the appropriate transfer in the near future (manuscript in preparation).

Cymbella cistula (Ehr. in Hempr. & Ehr.) Kirchner in Cohn var. cistula Pl. IX, Fig. 3 and 4, Slide #249-1 and #246-2 respectively.

Critical reference: Hustedt 1930, p. 363, Text fig. 676a.

Observed only in the lake (12 samples) where it appeared most often as an epiphyte or an epilith. Rare to uncommon in the samples. No clear indication of periodicity.

It appears that this taxon has been frequently confused with several other taxa, particularly my Cymbella species numbers 7 and 8. C. cistula var. cistula differs from these taxa in that its raphe ends turn abruptly, producing a raphe with parallel margins. The raphes of Cymbella species #7 and #8 taper gradually from the center toward the ends and are elongate-lanceolate in outline. C. cistula var. cistula also differs from Cymbella species #7 and #8 in the nature of its puncta.

Cymbella cuspidata Kütz. var. cuspidata Pl. VIII, Fig. 18, Slide #255-1.

Critical reference: Hustedt 1931 in Schmidt et al. 1874-1959, Pl. 374, Fig. 13-14.

Rare in three lake samples. On the stems of Nuphar variegatum at station 2 (22 July 1968), on Salix sp. roots at station 9 (15 April 1970), and on rocks in 2.1 m water at station 8 (22 July 1970).

Cymbella inaequalis (Ehr.) Rabh. var. inaequalis Pl. IX, Fig. 6, Slide #130-4.

Critical reference: Hustedt 1930, p. 356, Text fig. 656 (as C. ehrenbergii Kütz.).

Rare in three lake samples. In a long surface plankton tow taken across the lake from station 1 to 7 (23 June 1969), on rocks in 1.5 m water (including 61 cm ice covered with 13 cm snow) at station 12a (7 March 1969), and on rocks in 4.0 m water (including 61 cm ice covered with 15 cm snow).

Cymbella ehrenbergii Kütz. (1844) should be discarded since

Kützing quoted Navicula inaequalis Ehrenberg (1836) as a synonym when he proposed the name C. ehrenbergii. Realizing this, Ross (1952) made the combination Cymbella inaequalis. However, Rabenhorst (1847) had previously made the proper combination and, the author citation should read "(Ehr.) Rabenhorst" not "(Ehr.) Ross," as is sometimes seen in the literature.

Cymbella hustedtii Krasske var. hustedtii Pl. VIII, Fig. 23, Slide #215-3.

Critical reference: Krasske 1923, p. 204, Text fig. 11.

In three epilithic samples from lake station 8 and two scrapings from dock pilings (stations 6 and 10). Rare to uncommon in these samples. Observed in June, July and November.

Cymbella hybrida Grun. var. hybrida Pl. IX, Fig. 11, Slide #4-2.

Critical reference: Hustedt 1930, p. 357, Text fig. 652.

Rare in the surface sediment from 2-5 cm water at lake station 2 (22 July 1968).

Cymbella microcephala Grun. in Van Heurck var. microcephala Pl. VIII, Fig. 24 and Pl. XVIII, Fig. 11, Slide #57-1.

Critical reference: Van Heurck 1880-1883, Pl. 8, Fig. 36-39.

One of the most common diatoms of Clear Lake. Observed in 82% of all the non-plankton samples from the lake (69 samples). No clear indication of habitat preference or seasonal periodicity. Found only in a composite sample from the marsh (rare).

Granetti (1968) determined that Navicula casertana De Notaris (1872) is identical to Cymbella microcephala Grunow (1880) in Van Heurck (1880-1883), but did not officially make the combination Cymbella casertana.

Cholnoky (1968) stated that this taxon is a good indicator of weakly alkaline, oligotrophic conditions. Its abundance in Clear Lake strongly refutes Cholnoky's contention.

Cymbella obtusiuscula (Kütz.) Grun. var. obtusiuscula Pl. IX, Fig. 10, Slide #90-1.

Critical reference: Hustedt 1930, p. 352, Text fig. 640.

Rare in scrapings from dock pilings at lake station 10 (24 June 1969).

Cymbella prostrata (Berkeley) P. T. Cleve var. prostrata Pl. IX, Fig. 7 and 8, Slide #22-1 and #39-3 respectively.

Critical reference: Hustedt 1930, p. 357, Text fig. 659.

Rare in five lake samples. No clear indication of habitat preference or seasonal periodicity.

Cymbella ruttneri var. obtusa Hust. Pl. VIII, Fig. 17, Slide #113-4.

Critical reference: Hustedt 1938, p. 421, Pl. 25, Fig. 7-9.

Rare in scrapings of rocks from 60 cm water at lake station 15 (7 July 1969).

After examining my specimens of C. ruttneri var. obtusa and some specimens which have been identified as the nominate variety (Academy of Natural Sciences of Phila. General Collection #26146a--not type material), I have come to the tentative conclusion that C. ruttneri var. ruttneri and C. ruttneri var. obtusa, and perhaps the other varieties and forms which have been assigned to C. ruttneri, should be considered varieties or forms of Cymbella microcephala. A careful examination of type material appears to be in order.

Cymbella _schweickerdtii_ Cholnoky var. _schweickerdtii_ Pl. VIII, Fig. 15 and Pl. IX, Fig. 15, Slide #268-1 and #256-1 respectively.

Critical reference: Cholnoky 1958a, p. 60, Pl. 1, Fig. 29-30.

Found only in the lake (5 samples); rare in three epilithic samples, one epiphytic sample, and one scraping of dock pilings. No clear indication of periodicity.

Cymbella _sinuata_ Gregory var. _sinuata_ Pl. VIII, Fig. 14, Slide #255-1.

Critical reference: Hustedt 1930, p. 361, Text fig. 668.

A rare epiphyte on _Cladophora_ sp. at lake station 15 (7 July 1969) and on _Salix_ sp. roots at station 9 (15 April 1970).

Cymbella _triangulum_ (Ehr.) P. T. Cleve var. _triangulum_ Pl. IX, Fig. 9, Slide #4-2.

Critical reference: Hustedt 1955, p. 55, Text fig. 24-25.

Rare in the surface sediment from 2-5 cm water at lake station 2 (22 July 1968).

Cymbella _turgida_ var. _pseudogracilis_ Cholnoky Pl. VIII, Fig. 5-7, Slide #10-2.

Critical reference: Cholnoky 1958b, p. 112, Pl. 2, Fig. 49-50.

Rare to uncommon in 38 lake samples and rare in five marsh samples. No clear indication of habitat preference or seasonal periodicity.

Cymbella _ventricosa_ var. _splendens_ (A. Cleve) A. Cleve Pl. IX, Fig. 13, Slide #308-3.

Critical reference: Cleve-Euler 1955, p. 126, Fig. 1177x-y.

Observed only in squeezings of _Utricularia_ _vulgaris_ from marsh station VI (24 June 1970). Rare, but I have circled a number of specimens on slide #308-3.

There appears to be no justification for relating this taxon to *Cymbella ventricosa* which is a much smaller and more delicate diatom.

Cymbella sp. #6   Pl. VIII, Fig. 8, 19-22, Slide #87-3, #22-1, #86-6, #87-3 and #86-6 respectively.

Rare in 14 Clear Lake samples. Observed March to November. Found on a variety of substrates.

This taxon is probably a new variety of *Cymbella muelleri* Hustedt; to be published in the near future by Reimer (manuscript in preparation, personal communication).

Cymbella sp. #7   Pl. IX, Fig. 1, Slide #294-1.

Rare in 10 lake samples. No clear indication of habitat preference or periodicity.

It is very probable that this taxon, as well as *Cymbella* species #8, has frequently been confused with *Cymbella cistula* var. *cistula*. However, margins of the raphes of *Cymbella* species #7 and #8 taper gradually from the center toward the ends and, therefore, have an elongate-lanceolate appearance. The raphe of *Cymbella cistula* var. *cistula* has parallel margins except at the ends where it turns abruptly. Furthermore, the nature of the puncta of *Cymbella* species #7 and #8 differs from those of *C. cistula* var. *cistula*. Dr. Reimer was, to my knowledge, the first to recognize these differences and will publish his findings in the near future (manuscript in preparation, personal communication).

Cymbella sp. #8   Pl. IX, Fig. 2, Slide #113-4.

Rare in scrapings of rocks from 60 cm water at lake station 15 (7 July 1969) and from 15 cm water at lake station 8 (4 August 1969).

See discussion under *Cymbella* species #7 concerning possible confusion of this taxon with *C. cistula* var. *cistula*. This rather tumid taxon is probably a variety or form of *Cymbella* species #7, if not the same taxon.

Diatoma Bory nom. cons. non Loureiro

Diatoma vulgare Bory var. *vulgare* Pl. I., Fig. 16, Slide #215-4.

Critical reference: Patrick and Reimer 1966, p. 109, Pl. 2, Fig. 9.

Rare in three lake samples. Epiphytic on *Cladophora* sp. at station 11 (24 June 1969) and in scrapings of rocks from 30 cm water at stations 10 (24 June 1969) and 8 (10 November 1969).

Diploneis Ehr.

Diploneis oculata (Bréb.) P. T. Cleve var. *oculata* Pl. VI, Fig. 20, Slide #115-1.

Critical reference: Patrick and Reimer 1966, p. 412, Pl. 38, Fig. 6.

Rare in two lake samples. In scrapings from the tanks of a pontoon boat (7 July 1969) and in scrapings from dock pilings at station 10 (23 November 1968).

Diploneis ovalis (Hilse) P. T. Cleve var. *ovalis* Pl. VI, Fig. 21, Slide #279-2.

Critical reference: Hustedt 1937, p. 671, Text fig. 1065a-e.

Rare in two marsh samples. In squeezings of grasses in 15 cm water at station XII (13 May 1970) and in the surface sediment from 60 cm water at station XIII (13 May 1970).

Epithemia Bréb.

Epithemia sorex Kütz. var. sorex Pl. XIII, Fig. 21, Slide #263-1.

Critical reference: Hustedt 1930, p. 388, Text fig. 736.

Rare in three lake samples. In the surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at station 12a (7 March 1969) and in scrapings of rocks from 15 cm water at station 8 (22 July 1969) and 30 cm water at station 8a (29 April 1970).

Epithemia turgida (Ehr.) Kütz. var. turgida Pl. XIV, Fig. 1-6, Slide #278-2, #162-2, #162-1, #162-1, #162-1 and #162-2 respectively.

Critical reference: Hustedt 1930, p. 387, Text fig. 734.

Found in seven marsh samples and two lake samples. In the marsh it has been observed in surface sediments (rare to uncommon), in scrapings from a floating plank (rare) and in epiphytic samples. Its best development was as an epiphyte. Very abundant in a squeezing of a mixed population of Lemna minor and L. trisulca, common on Drepanocladus aduncus, and uncommon on Utricularia vulgaris. Most abundant in August when the Lemna populations were very substantial. Rare in the surface sediment from 3.7 m water at lake station 13 (6 March 1969) and in scrapings of rocks from 2.1 m water at lake station 8 (22 July 1970).

I do not believe that Epithemia turgida var. granulata (Ehr.) Grun. is a distinct taxon and have not separated it from the nominate variety. I have observed and illustrated a series of specimens which range in size from 194 microns to 46 microns (Pl. XIV, Fig. 1-6). The larger members of this series (Fig. 2-3) fit the description of E. turgida var. granulata while the smaller specimens fit the description of the nominate variety. It is apparent that the only significant difference in these specimens is size and that they should be considered one taxon. Figures 1 and 1a represent a post-auxospore cell and probably the maximum size for this taxon while Figures 5 and 6 illustrate cells which are approaching the lower size limit (cells at the lower size limit frequently become somewhat concave ventrally).

Epithemia zebra var. *saxonica* (Kütz.) Grun. Pl. XIII, Fig. 22, Slide #96-1.

Critical reference: Hustedt 1930, p. 385, Text fig. 730.

Found in 12 lake samples (rare to uncommon) and 13 marsh samples (rare to common). In a variety of habitats with no clear indication of preference in either study area. Observed March to November, but rare in all samples except those collected in March (Clear Lake) and May (Ventura Marsh).

Eunotia Ehr.

Eunotia curvata (Kütz.) Lagerstedt var. *curvata* Pl. III, Fig. 5, Slide #261-2.

Critical reference: Patrick and Reimer 1966, p. 189, Pl. 10, Fig. 4.

Found in 17 marsh samples and only one lake sample. Best development as an epiphyte in the marsh. Abundant in squeezings of *Sagittaria* sp. stems at station VI (7 July 1969); rare to common in the other epiphytic samples and rare to uncommon in the remaining marsh samples. Rare in the surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969).

Eunotia formica Ehr. var. *formica* Pl. III, Fig. 3-4, Slide #282-1.

Critical reference: Patrick and Reimer 1966, p. 190, Pl. 10, Fig. 7.

Rare to uncommon in five marsh samples and rare in one lake sample. Seems to prefer surface sediments. No clear indication of periodicity.

Eunotia pectinalis var. minor (Kütz.) Rabh. Pl. III, Fig. 6, Slide #78-2.

Critical reference: Patrick and Reimer 1966, p. 207, Pl. 12, Fig. 13-14.

Observed in one lake sample and one marsh sample. Rare in the surface sediment in 3.7 m water at lake station 13 (6 March 1969) and rare on grasses in one of the drainage ditches flowing into the marsh (7 July 1969).

Fragilaria Lyngb.

Fragilaria brevistriata Grun. var. brevistriata Pl. II, Fig. 2, Slide #179-3.

Critical reference: Patrick and Reimer 1966, p. 128, Pl. 4, Fig. 14.

Found only in Clear Lake (45 samples) and in a great variety of habitats, no clear indication of habitat preference. Observed from March to November.

Fragilaria brevistriata var. inflata (Pantocsek) Hust. Pl. II, Fig. 3, Slide #179-1.

Critical reference: Patrick and Reimer 1966, p. 129, Pl. 4, Fig. 16.

A rare diatom in scrapings of rocks from just below the water surface at lake station 8 (15 September 1969).

Fragilaria brevistriata var. subcapitata Grun. Pl. II, Fig. 4, Slide #324-2.

Critical reference: Hustedt 1931, p. 169, Text fig. 676g.

Rare in one lake sample; surface sediment from 1.8 m water at station 8 (22 July 1970).

Fragilaria capucina Desmazieres var. capucina Pl. II, Fig. 15, Slide #226-3.

Critical reference: Patrick and Reimer 1966, p. 118, Pl. 3, Fig. 5.

Found in 59 lake samples and 22 marsh samples. Rare to common in a great variety of habitats. Abundant in a surface sediment sample from a shallow pool which was somewhat protected against wave action by rocks (station 9, 23 July 1968). No clear indication of seasonal periodicity.

Fragilaria capucina var. mesolepta Rabh. Pl. II, Fig. 16, Slide #255-1.

Critical reference: Patrick and Reimer 1966, p. 119, Pl. 3, Fig. 6.

An extremely prominent diatom in both study areas, found in a total of 116 samples including 75 lake samples and 41 marsh samples. Very abundant in 23 samples, abundant in 40 samples, common in 25 samples and rare to uncommon in the remaining 28 samples. Best development in the plankton of the lake and the marsh. A major contributor to the lake plankton from 15 April 1970 to 10 June 1970 with a maximum standing crop on 29 April (1.4×10^6 cells/liter). A major contributor to the marsh plankton from 27 May 1970 to 24 June 1970 with a maximum standing crop on 27 May (5.1×10^5 cells/liter).

Fragilaria construens (Ehr.) Grun. var. construens Pl. II, Fig. 13, Slide #78-2.

Critical reference: Patrick and Reimer 1966, p. 125, Pl. 4, Fig. 4.

Found in 38 lake samples and only one marsh sample. In a variety of lake habitats, but seems to have its best development (uncommon to common in 7 samples, rare in 2 samples) in the surface sediments. Rare to uncommon in the remaining lake samples. No clear indication of periodicity. Rare in one of the drainage ditches leading into the marsh (station III, 7 July 1969).

Fragilaria construens var. venter (Ehr.) Grun. Pl. II, Fig. 14, Slide #325-1.

Critical reference: Patrick and Reimer 1966, p. 126, Pl. 4, Fig. 8-9.

Found in 21 lake samples. Rare to uncommon in a variety of habitats. Appears to develop best in the surface sediments. No clear indication of periodicity.

Fragilaria crotonensis Kitton var. crotonensis Pl. II, Fig. 9, Slide #130-3.

Critical reference: Patrick and Reimer 1966, p. 121, Pl. 3, Fig. 11-12.

Found in more Clear Lake samples (94) than any other taxon except Melosira ambigua var. ambigua (103). In nine marsh samples. With the exception of one sample, it was abundant to very abundant in the lake plankton where it reached its best development on 29 April 1970 (1.5×10^6 cells/liter). An important plankter in the marsh also, reaching a maximum standing crop on 27 October 1969 (9.3×10^4 cells/liter).

Fragilaria crotonensis var. prolongata Grun. in Van Heurck Pl. II, Fig. 8, Slide #215-1.

Critical reference: Van Heurck 1880-1883, Pl. 40, Fig. 10 [as Synedra crotonensis var. prolongata Grun. forma belgica (Fragilaria? crotonensis Kitton var.). However, in the text (Van Heurck, 1885, p. 156) which was written to accompany the atlas, Van Heurck applied the name Fragilaria crotonensis var. prolongata Grun. to the same illustration and type material].

Patrick and Reimer (1966) placed this taxon into synonomy with the nominate variety. I have seen Van Heurck material of F. crotonensis var. prolongata (Van Heurck Exsiccata, slide #319, Academy of Natural Sciences of Philadelphia) and it agrees well with my specimens except in being somewhat more coarsely striated (my material, 18 striae/10 microns; Van Heurck material, 16/10 microns). Both my specimens and the Van Heurck specimens vary from inflated to parallel-margined at the central area and, when adjacent cells are united, their valves are adnate throughout their length. The nominate variety is always inflated at the central area and, when forming chains of cells, the valves are adnate only in the middle portion. Furthermore, I was unable to find chains of more than two united cells in either my material or Van Heurck's material of F. crotonensis var. prolongata while the nominate variety forms long chains containing up to several hundred cells. These factors have led me to believe that the two taxa should be considered as distinct. The apparent inability of F. crotonensis var. prolongata to form long chains of cells is probably the reason that Grunow originally placed it in the genus Synedra.

Fragilaria pinnata var. lancettula (Schumann) Hust. Pl. II, Fig. 5 and 6, Slide #4-1 and #11-2 respectively.

Critical reference: Patrick and Reimer 1966, p. 128, Pl. 4, Fig. 12.

Found in 43 lake samples and two marsh samples. Rare to common in a variety of lake habitats, no clear indication of periodicity. Rare in the marsh plankton at station X (23 December 1969 and 29 April 1970).

Fragilaria vaucheriae (Kütz.) Petersen var. vaucheriae Pl. II, Fig. 10 and 11, Slide #158-2 and #115-2 respectively.

Critical reference: Patrick and Reimer 1966, p. 120, Pl. 3, Fig. 14-15.

An extremely prominent diatom in both study areas, but especially in the lake. Found in 80 lake samples and 34 marsh samples. Rare to very abundant in a great variety of lake habitats, with its best development as an epiphyte and an epilith. Most abundant in the lake during June and July. Rare to uncommon in a variety of marsh habitats; common only in scrapings from a plank which was submersed in 2-5 cm water at station I (15 April 1970).

Fragilaria vaucheriae var. capitellata (Grun.) Patr. Pl. II, Fig. 12, Slide #158-3.

Critical reference: Patrick and Reimer 1966, p. 121, Pl. 3, Fig. 16.

Found in eight lake samples and four marsh samples. Rare in all lake samples; six of the eight samples were rock scrapings. Rare in two surface sediment samples from the marsh and one scraping from a submersed plank; uncommon in one plankton sample. No clear indication of periodicity.

Fragilaria virescens Ralfs var. virescens Pl. II, Fig. 7, Slide #161-2.

Critical reference: Patrick and Reimer 1966, p. 119, Pl. 3, Fig. 7-9.

In 11 marsh samples and only one lake sample. Seven of the 11 marsh samples were from the surface sediment where this taxon was rare to uncommon, but it reached its best development (abundant) as an epiphyte on grasses at marsh station XII (13 May 1970). No clear indication of seasonal periodicity in the marsh. Rare on Typha latifolia at lake station 2 (23 November 1968).

Gomphonema Ehr. nom. cons. non Agardh

Gomphonema acuminatum Ehr. var. acuminatum Pl. XII, Fig. 30, Slide #132-4.

Critical reference: Mayer 1928, p. 93, Pl. 1, Fig. 14-16.

Rare in surface sediment from 30 cm water at marsh station VII (21 July 1969).

Gomphonema acuminatum var. brebissonii (Kütz.) P. T. Cleve Pl. XII, Fig. 32-34, Slide #92-1, #278-1, and #278-1 respectively.

Critical reference: Mayer 1928, p. 94, Pl. 1, Fig. 17-21.

Found in three marsh samples and one lake sample. Rare in surface sediment at marsh stations X (29 April 1970) and XIII (13 May 1970) and rare in squeezings of Drepanocladus aduncus at marsh station XII (13 May 1970). Rare in squeezings of a submersed burlap bag at lake station 10 (24 June 1969).

Gomphonema acuminatum var. elongata (Wm. Smith) Van Heurck Pl. XII, Fig. 31, Slide #278-1.

Critical reference: Schmidt and Fricke 1902 in Schmidt et al. 1874-1959, Pl. 239, Fig. 28-30.

Rare in squeezings of Drepanocladus aduncus at marsh station XII (13 May 1970).

Gomphonema angustatum (Kütz.) Rabh. var. angustatum Pl. XII, Fig.

17-18, Slide #118-2 and #119-1 respectively.

Critical reference: Hustedt 1930, p. 373, Text fig. 690.

In 10 marsh samples and one lake sample. Best development in the four samples collected from the drainage ditches leading into the marsh--abundant (station IV) and very abundant (station III) in two grass squeezings, very abundant in a surface sediment sample (station IV), and uncommon in the scrapings of broken clay tile in 75 cm water (station III). All the drainage ditch samples were collected on 7 July 1969 at which time the ditches were highly enriched (see comments under Achnanthes lanceolata var. lanceolata in this section). Rare to common in the remaining marsh samples. Rare in one surface sediment sample collected at lake station 12a (7 March 1969), but probably transported there from the marsh (station 12a is only a short distance from the channel connecting the marsh to the lake).

Gomphonema angustatum var. sarcophagus (Gregory) Grun. Pl. XII, Fig. 19 and 20, Slide #284-2 and #118-3 respectively.

Critical reference: Hustedt 1930, p. 373, Text fig. 691.

Rare in four marsh samples. An epiphyte on grasses and in the surface sediment from 30 cm water from a drainage ditch leading into the marsh (station IV, 7 July 1969). Also in the surface sediments from station X (29 April 1970) and station XIV (13 May 1970).

Gomphonema carolinense Hagelstein var. carolinense Pl. XII, Fig. 23, Slide #132-5.

Critical reference: Hagelstein 1938, p. 360, Pl. 5, Fig. 6.

Rare in four marsh samples. In the surface sediments from stations VII (21 July 1969), X (29 April 1970) and XI (27 October 1969).

Epiphytic on Potamogeton pectinatus at station I (23 November 1968).

Gomphonema constrictum Ehr. var. constrictum Pl. XII, Fig. 24, Slide #308-3.

Critical reference: Schmidt and Fricke 1904 in Schmidt et al. 1874-1959, Pl. 247, Fig. 10.

Rare in seven marsh samples and one lake sample. Most frequently observed as an epiphyte on a variety of plants in the marsh. Rare on submersed Salix sp. stems at lake station 8 (4 August 1969). Observed June to November.

Gomphonema constrictum var. capitatum (Ehr.) Van Heurck Pl. XII, Fig. 26, Slide #283-1.

Critical reference: Van Heurck 1880-1883, Pl. 23, Fig. 9.

A rare epiphyte in three marsh samples; on Ceratophyllum demersum at station VII (21 July 1969), on Typha latifolia at station I (1 April 1970), and in mixed squeezings of dead and decaying Typha latifolia and Scirpus sp. at station XIV (13 May 1970).

Gomphonema constrictum f. parva Grun. Pl. XII, Fig. 27, Slide #132-6.

Critical reference: Schmidt and Fricke 1904 in Schmidt et al. 1874-1959, Pl. 247, Fig. 18-19.

A rare epiphyte on Potamogeton nodosus at lake station 12 (23 November 1968) and rare in one marsh plankton sample at station X (27 October 1969).

Gomphonema constrictum var. subcapitata Grunow in Van Heurck Pl. XII, Fig. 25, Slide #80-4.

Critical reference: Van Heurck 1880-1883, Pl. 23, Fig. 5.

Rare in the surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969).

Gomphonema gracile var. aurita (A. Braun) Van Heurck Pl. XIII, Fig. 13, Slide #2-1.

Critical reference: Schmidt and Fricke 1902 in Schmidt et al. 1874-1959, Pl. 236, Fig. 20-24.

Rare in one lake sample and one marsh sample. A rare epiphyte on Heteranthera dubia at lake station 8 (4 August 1969) and on Drepanocladus aduncus at marsh station XII (13 May 1970).

Gomphonema gracile var. lanceolata (Kütz.) P. T. Cleve sensu Fricke Pl. XIII, Fig. 14, Slide #27-1.

Critical reference: Schmidt and Fricke 1902 in Schmidt et al. 1874-1959, Pl. 236, Fig. 25-28.

Found in nine lake samples and five marsh samples. Observed in a variety of lake habitats, rare to uncommon. Found only as an epiphyte in the marsh, rare to uncommon on a variety of plants. No clear indication of periodicity in the lake, observed May to November in the marsh.

Gomphonema gracile var. naviculoides (Wm. Smith) Grunow in Van Heurck Pl. XIII, Fig. 15, Slide #246-1.

Critical reference: Van Heurck 1880-1883, Pl. 24, Fig. 13.

In eight lake samples (rare to uncommon) and five marsh samples (rare). No clear indication of habitat preference or periodicity in the lake. Epiphytic on a variety of plants in the marsh and in one surface sediment sample; observed from May to August.

Gomphonema gracile var. ? Pl. XIII, Fig. 16 and 17, Slide #283-2 and #283-4 respectively.

Found in seven lake samples (rare to uncommon) and four marsh samples (rare). Most often encountered as an epiphyte on a variety of plants in both habitats. Observed March to November.

A thorough search of the literature has not resulted in a name for this variety--probably a new variety.

Gomphonema insigne Gregory var. insigne Pl. XIII, Fig. 1, Slide #132-3.

Critical reference: Mayer 1928, p. 114, Pl. 3, Fig. 20.

In five marsh samples (rare to uncommon) and one lake sample (rare). No clear indication of habitat preference. Observed March to October.

Gomphonema insigne var. elongatum Mayer Pl. XIII, Fig. 2 and 3, Slide #124-3 and #80-2 respectively.

Critical reference: Mayer 1928, p. 115, Pl. 3, Fig. 22.

Observed in two marsh samples and one lake sample. A rare epiphyte on Potamogeton sp. at marsh station II (8 July 1969); rare in the marsh plankton at station X (27 October 1969). Rare in one surface sediment sample from lake station 12a (7 March 1969), but possibly transported there from the marsh since station 12a is only a short distance from the channel connecting the two study areas.

Gomphonema intricatum var. intricatum Kütz. Pl. XIII, Fig. 9, Slide #162-1.

Critical reference: Schmidt and Fricke 1902 in Schmidt et al. 1874-1959, Pl. 234, Fig. 48.

Observed in only two samples. Rare in squeezings of Lemna trisulca and L. minor at marsh station VI (4 August 1969). Rare in a composite sample from the lake.

Gomphonema intricatum var. pumila Grunow in Van Heurck Pl. XIII, Fig. 12, Slide #158-1.

Critical reference: Schmidt and Fricke 1902 in Schmidt et al. 1874-1959, Pl. 234, Fig. 57.

Found in 13 lake samples and only one marsh sample. Best development (rare to common) as an epiphyte on a variety of plants in the lake, but also found in a variety of other habitats; encountered most often in July and August. Rare on Drepanocladus aduncus at marsh station XII (13 May 1970).

Gomphonema intricatum var. vibrio (Ehr.) P. T. Cleve Pl. XIII, Fig. 10 and 11, Slide #308-2 and #283-1 respectively.

Critical reference: Schmidt and Fricke 1902 in Schmidt et al. 1874-1959, Pl. 235, Fig. 4-14.

In four marsh samples and one lake sample. A rare epiphyte on a variety of plants in the marsh (May to August) and on Potamogeton nodosus at lake station 8 (4 August 1969).

Gomphonema montanum var. subclavata Grun. Pl. XII, Fig. 36 and 37, Slide #26-3 and #281-2 respectively.

Critical reference: Mayer 1928, p. 112, Pl. 3, Fig. 9.

Found in 25 marsh samples and seven lake samples. Observed in a variety of marsh habitats, but appears to prefer plant substrates; rare to common as an epiphyte, rare to uncommon in other samples. No strong indication of periodicity, but encountered most frequently during July and August. Rare in a variety of lake habitats with no clear indication of periodicity.

Gomphonema olivaceoides Hust. var. olivaceoides Pl. XII, Fig. 22, Slide #226-1.

Critical reference: Hustedt 1950, p. 397, Pl. 37, Fig. 9-12.

Found in 14 lake samples and two marsh samples. In a variety of lake habitats, but best development on rocks; very abundant in scrapings from rocks in 45 cm water (including 10 cm ice covered with 10 cm snow) at station 8 (6 January 1970). Hustedt (1950) also reported it as abundant on rocks in a number of lakes in northern Germany. Encountered mostly in samples collected from January to April. Rare in scrapings from a plank submersed in 2-5 cm water at marsh station I (15 April 1970) and in the marsh plankton at station X (15 April 1970).

Gomphonema olivaceum (Lyngbye) Kütz. var. olivaceum Pl. XII, Fig. 21, Slide #238-1.

Critical reference: Hustedt 1930, p. 378, Text fig. 719.

The most frequently encountered Gomphonema in Clear Lake. Found in 43 lake samples and three marsh samples. Observed from a great variety of lake habitats, but its best development is as an epiphyte or an epilith. Most prominent from March to July, but observed during all seasons. Rare in the surface sediment from 60 cm water at marsh station VI (4 August 1969) and in two plankton samples from marsh station X (23 December 1969 and 15 April 1970).

Gomphonema parvulum (Kütz.) Grun. var. parvulum Pl. XII, Fig. 15, Slide #26-3.

Critical reference: Hustedt 1930, p. 372, Text fig. 713a.

The most frequently encountered Gomphonema in Ventura Marsh. In 44 marsh samples (including 76% of the non-plankton samples) and nine lake samples. In a great variety of marsh habitats with no clear indication of preference; rare to abundant in the samples; no clear indication of periodicity. Rare to uncommon in the lake samples; no habitat preference or seasonal periodicity is apparent.

Gomphonema parvulum var. micropus (Kütz.) P. T. Cleve Pl. XII, Fig. 16, Slide #26-3.

Critical reference: Hustedt 1930, p. 373, Text fig. 713c.

This taxon, like the nominate variety, is also predominantly a marsh form; in 17 marsh samples (rare to common) and two lake samples. Appeared in a variety of habitats, but developed best as an epiphyte on a variety of plants. Observed from April to August in the marsh. Found as a rare epiphyte on filamentous green algae at lake station 8a (4 August 1969), and rare in the surface sediment at station 12a (7 March 1969).

Gomphonema sphaerophorum Ehr. var. sphaerophorum Pl. XII, Fig. 28, Slide #80-3.

Critical reference: Mayer 1928, p. 100, Pl. 2, Fig. 18.

Found in two lake samples and two marsh samples. Rare in a sample of Spirogyra sp. from splash zone of rocks at lake station 12 (23 November 1968)--I have been unable to find any epiphytes on the Spirogyra sp. itself and believe that the diatoms in this sample have simply been trapped there. Rare in the surface sediments at lake station 12a (7 March 1969). Rare in two plankton samples from marsh station X (4 August 1969 and 18 August 1969).

Gomphonema subclavatum Grun. var. subclavatum Pl. XIII, Fig. 6 and 7, Slide #325-2 and #279-1 respectively.

Critical reference: Schmidt and Fricke 1902 in Schmidt et al. 1874-1959, Pl. 238, Fig. 15-18.

In one marsh sample and one lake sample. Rare in squeezings of grasses at marsh station XII (13 May 1970) and in surface sediments from

3.0 m at lake station 8 (22 July 1970).

Gomphonema subclavatum var. mexicanum (Grun.) Patr. Pl. XIII, Fig. 8, Slide #321-2.

Critical reference: Van Heurck 1880-1883, Pl. 24, Fig. 3 [as G. (commutatum var. ?) mexicanum Grun.].

Found only in the marsh (seven samples). Best development (rare to common) as an epiphyte on a variety of plants in July and August. Also rare in one surface sediment sample at station XI (27 October 1969) and in one plankton sample from station X (18 August 1969).

Gomphonema subtile Ehr. var. subtile Pl. XII, Fig. 29, Slide #11-1.

Critical reference: Mayer 1928, p. 101, Pl. 2, Fig. 20 (as Gomphonema subtile f. angusta).

Found only in one lake sample; rare in squeezings of Vallisneria americana at station 3 (23 July 1968).

Gomphonema tenellum Kütz. var. tenellum Pl. XII, Fig. 35, Slide #306-1.

Critical reference: Hustedt 1945, p. 941, Pl. 42, Fig. 50-56.

Found in 33 lake samples and two marsh samples. In a variety of lake habitats with no indication of preference (rare to uncommon); observed March to November. A rare epiphyte on grasses in one of the drainage ditches leading into the marsh (station III, 7 July 1969) and rare in the surface sediments at marsh station XIII (13 May 1970).

Gomphonema turris Ehr. var. turris Pl. XIII, Fig. 4 and 5, Slide #132-7 and #132-3 respectively.

Critical reference: Mayer 1928, p. 109, Pl. 3, Fig. 2.

Found only in one marsh sample; rare in surface sediments from station VII (21 July 1969).

Gyrosigma Hassall nom. cons.

Gyrosigma attenuatum (Kütz.) Rabh. attenuatum Pl. V, Fig. 2, Slide #246-1.

Critical reference: Patrick and Reimer 1966, p. 319, Pl. 24, Fig. 1.

Rare in three lake samples. In the surface sediments in 1.8 m water at station 8 (22 July 1970), in rock scrapings from 1 m water at station 8 (17 March 1970), and in the plankton at station 8 (27 October 1969).

Gyrosigma spencerii (Quekett) Griffith & Henfrey var. spencerii Pl. V, Fig. 1, Slide #5-1.

Critical reference: Patrick and Reimer 1966, p. 315, Pl. 23, Fig. 4.

Rare in two lake samples. In surface sediments in 3.7 m water at station 13 (6 March 1969) and in scrapings from stems of Nuphar variegatum at station 2 (22 July 1968).

Hantzschia Grunow nom. cons. non Auerswald

Hantzschia amphioxys (Ehr.) Grun. var. amphioxys Pl. XIII, Fig. 18, Slide #118-3.

Critical reference: Hustedt 1930, p. 394, Text fig. 747.

Found in five marsh samples and two lake samples. Rare in four surface sediment samples from the marsh (stations IV, I, XI and XIII; collected on 7 July 1969, 29 September 1969, 27 October 1969, and 13 May 1969 respectively). Uncommon on grasses in a drainage ditch leading into the marsh (station IV, 7 July 1969). Rare on Cladophora sp. at lake station 6 (23 July 1968) and in scrapings from the tanks of a pontoon boat (7 July 1969).

Hustedt (1930) gave a stria count of 13-20 in 10 microns for this taxon, but my specimens have up to 24 striae in 10 microns. Lund (1946) also found finely striated specimens, his specimens varying from 14-25 in 10 microns. However, Lund's specimens were living in the soil.

Hantzschia amphioxys var. maior Grun. Pl. XIII, Fig. 19, Slide #279-2.

Critical reference: Hustedt 1930, p. 394, Text fig. 749.

Found in only one marsh sample. A rare epiphyte on grasses in approximately 15 cm water at station XII (13 May 1970).

Hantzschia amphioxys var. vivax (Hantzsch) Grun. Pl. XIII, Fig. 20, Slide #132-2.

Critical reference: Hustedt 1930, p. 394, Text fig. 750.

Rare in one marsh sample; in the surface sediment in 30 cm water at station VII (21 July 1969).

Mastogloia Thwaites

Mastogloia grevillei Wm. Smith var. grevillei Pl. III, Fig. 19, Slide #179-1.

Critical reference: Patrick and Reimer 1966, p. 298, Pl. 20, Fig. 8-9.

Rare in two rock scrapings from Clear Lake station 8, just below water surface (15 September 1969) and from 30 cm water (15 April 1970).

Melosira Agardh nom. cons.

Melosira ambigua (Grun.) O. Müller var. ambigua Pl. I, Fig. 14, Slide #93-1.

Critical reference: Hustedt 1927, p. 256, Text fig. 108.

The most commonly encountered diatom in Clear Lake. In 102 lake samples and 12 marsh samples. Best development in the lake plankton where it is found throughout the year except in February; reached its maximum standing crop on 13 May 1970 (9.7×10^5 cells/liter). In the marsh it is most often found in the plankton. No clear indication of periodicity in the marsh.

Melosira granulata (Ehr.) Ralfs in Pritchard var. granulata Pl. I, Fig. 9 and 10, Slide #8-1 and #93-2 respectively.

Critical reference: Hustedt 1927, p. 248, Text fig. 104.

Observed from 81 lake samples and three marsh samples. Best development in the lake plankton where it occurred during all months of the year except December, February and March; reached its peak abundance on 13 October 1969 (2.8×10^5 cells/liter) and 24 June 1970 (2.6×10^5 cells/liter). Rare in one plankton sample, one surface sediment sample and one epiphytic sample from the marsh.

Melosira granulata var. angustissima O. Müller Pl. I, Fig. 11, Slide #261-1.

Critical reference: Hustedt 1927, p. 250, Text fig. 104d.

In 28 marsh samples and 10 lake samples. Best development in the marsh plankton where it appeared in every sample; reached its maximum standing crop on 2 September 1969 (2.0×10^6 cells/liter) and was a major contributor from 2 September 1969 to 27 October 1969. Rare to common in a variety of lake habitats, but most frequently encountered in the plankton; observed from January to November.

Melosira italica (Ehr.) Kütz. var. italica Pl. I, Fig. 13, Slide #308-3.

Critical reference: Hustedt 1927, p. 257, Text fig. 109c.

Found in five marsh samples. An uncommon epiphyte on *Drepanocladus aduncus* at station XII (13 May 1970) and on *Utricularia vulgaris* at station VI (24 June 1970); rare in surface sediment samples at station VI (4 August 1969) and station XII (13 May 1970); rare in the plankton at station X (24 June 1970).

Melosira varians Agardh var. *varians* Pl. I, Fig. 12, Slide #304-2.

Critical reference: Hustedt 1927, p. 240, Text fig. 100.

Rare in three lake samples. In rock scrapings from 15 cm water at station 8 (22 July 1969); in the plankton at station 8 (3 March 1970); in squeezings of *Cladophora* sp. at station 16 (24 June 1970).

Meridion Agardh

Meridion circulare (Grev.) Agardh var. *circulare* Pl. I, Fig. 17, Slide #118-1.

Critical reference: Patrick and Reimer 1966, p. 113, Pl. 2, Fig. 15.

Found in six marsh samples--three epiphytic samples and three surface sediment samples. As an epiphyte it is common on grasses in a drainage ditch (station IV, 7 July 1969), rare in mixed plant squeezings at station V (7 July 1969), and uncommon on grasses at station XII (13 May 1970). In the surface sediment it is common in a drainage ditch (station IV, 7 July 1969), rare at station IX (21 July 1969), and rare at station XIV (13 May 1970). Its appearance in three drainage ditch samples is not surprising since this taxon is considered by many to be a rheophil.

Navicula Bory

Navicula abiskoensis Hust. var. abiskoensis Pl. XI, Fig. 23, Slide #132-2.

Critical reference: Hustedt 1942a, p. 118, Text fig. 36.

Rare in four marsh samples and two lake samples. An epiphyte on Typha latifolia at marsh station I (1 April 1970), in the surface sediments at marsh stations VII and XIII (21 July 1969 and 13 May 1970 respectively), and in the marsh plankton at station X (29 April 1970). In the surface sediments at lake station 10 (23 July 1968) and in rock scrapings at station 2 (22 July 1968).

Navicula abiskoensis Hust. f. ? Pl. XI, Fig. 24, Slide #322-1.

Rare at station X on stems of Nymphaea tuberosa (22 July 1970).

This taxon varies from the nominate variety in being smaller and in having subrostrate rather than capitate ends.

Navicula accomoda Hust. var. accomoda Pl. XI, Fig. 27, Slide #284-1.

Critical reference: Patrick and Reimer 1966, p. 468, Pl. 44, Fig. 7.

Rare in two marsh samples; on Spartina sp. which was in 2-7 cm water at station IX (21 July 1969) and in the surface sediment at station XIV (13 May 1970).

Navicula amphibola P. T. Cleve var. amphibola Pl. X, Fig. 31, Slide #132-12.

Critical reference: Patrick and Reimer 1966, p. 445, Pl. 39, Fig. 7-8.

Rare in two surface sediment samples from the marsh; in 60 cm water at station XIII (13 May 1970) and in 30 cm water at station VII (21

July 1969).

Navicula anglica Ralfs var. anglica   Pl. XII, Fig. 9, Slide #80-3.

Critical reference: Hustedt 1930, p. 303, Text fig. 530-531.

Rare in two surface sediment samples from Clear Lake; at station 2 in 2-5 cm water (22 July 1968) and at station 12a in 1.5 m water (7 March 1969; 61 cm ice covered by 13 cm snow).

Navicula aurora Sovereign var. aurora   Pl. X, Fig. 20, Slide #78-2.

Critical reference: Sovereign 1958, p. 120, Pl. 3, Fig. 29-31.

Rare in two lake samples; in scrapings from dock pilings from the water surface to 30 cm below water surface at station 10 (23 November 1968) and in surface sediments in 3.7 m water at station 13 (6 March 1969).

Navicula bacillum Ehr. var. bacillum   Pl. XII, Fig. 14, Slide #39-3.

Critical reference: Patrick and Reimer 1966, p. 494, Pl. 46, Fig. 4-5.

Rare in three lake samples. In rock scrapings from 30-40 cm water at station 8 (24 June 1970), in scrapings from dock pilings from the water surface to 30 cm below the water surface at station 10 (23 November 1968), and in the plankton at station 8 (13 May 1970).

Navicula biconica Patr. var. biconica   Pl. XI, Fig. 25, Slide #332-1.

Critical reference: Patrick and Reimer 1966, p. 469, Pl. 44, Fig. 8.

Rare in three marsh samples. An epiphyte on Spartina sp. in 2-7 cm water at station IX (21 July 1969); in the surface sediment in 13 to 15 cm water at station I (4 August 1969); in the plankton at station X (27 October 1969).

Navicula bryophila Petersen var. bryophila   Pl. XI, Fig. 21, Slide

#246-2 and Pl. XVIII, Fig. 4.

Critical reference: Hustedt 1961, p. 91, Text fig. 1237.

Found in seven lake samples and two marsh samples. Best development in the lake where it is rare to uncommon. Seems to prefer rock substrates (five of the seven samples were rock scrapings), but also encountered on dock pilings (rare) and in one plankton sample (rare). No indication of periodicity in the lake. A rare epiphyte on Drepanocladus aduncus at marsh station XII (13 May 1970) and in scrapings from a floating plank at marsh station XIII (13 May 1970).

Navicula capitata Ehr. var. capitata Pl. XII, Fig. 12, Slide #54-3.

Critical reference: Patrick and Reimer 1966, p. 536, P.. 52, Fig. 1-2.

In 17 marsh samples and three lake samples. Rare to common in a variety of marsh habitats; no clear indication of periodicity. A rare epiphyte on Myriophyllum sp. at lake station 2 (23 November 1968), rare in the surface sediments at station 10 (23 July 1968) and rare in the plankton at lake station 8 (4 February 1970).

Navicula capitata var. hungarica (Grun.) Ross Pl. XII, Fig. 13, Slide #132-10.

Critical reference: Patrick and Reimer 1966, p. 537, Pl. 52, Fig. 3.

In 19 marsh samples and seven lake samples. Rare to common in a variety of marsh habitats; no clear indication of periodicity. Rare in a variety of lake samples; observed June to November.

Navicula cincta var. rostrata Reimer Pl. X, Fig. 5, Slide #281-2.

Critical reference: Reimer 1961, p. 314, Pl. 1, Fig. 1.

Found in 17 marsh samples and two lake samples. Rare to common in a variety of marsh habitats; no clear indication of periodicity. Rare in the surface sediment from 15 cm water at lake station 12 (23 November 1968) and rare in scrapings of rocks from 15-30 cm water at station 2 (22 July 1968).

Navicula confervacea (Kütz.) Grun. var. confervacea Pl. XI, Fig. 26, Slide #132-4 and Pl. XVIII, Fig. 3.

Critical reference: Patrick and Reimer 1966, p. 476, Pl. 45, Fig. 9.

Rare in the surface sediment from 30 cm water at marsh station VII (21 July 1969) and 60 cm water at marsh station XII (13 May 1970).

Navicula contenta f. parallela Petersen Pl. X, Fig. 23, Slide #278-1.

Critical reference: Hustedt 1962, p. 209, Text fig. 1328e-g.

A rare epiphyte on Potamogeton pectinatus at marsh station I (23 November 1968) and on Drepanocladus aduncus at marsh station XII (13 May 1970).

Navicula cryptocephala Kütz. var. cryptocephala Pl. X, Fig. 8, Slide #308-1.

Critical reference: Patrick and Reimer 1966, p. 503, Pl. 48, Fig. 3.

Observed in 24 marsh samples and 19 lake samples. Rare to uncommon in a variety of marsh habitats, but very abundant as an epiphyte on Utricularia vulgaris at station VI (24 June 1970). Rare to uncommon in a variety of lake habitats. No clear indication of periodicity in either study area.

Navicula cryptocephala f. minuta Petersen Pl. X, Fig. 10, Slide #11-3.

Critical reference: Petersen 1943, p. 79, Text fig. 1.

This taxon is definitely a lake form; found in 66 lake samples and no marsh samples. Rare to common in a great variety of habitats; no clear indication of habitat selection or periodicity.

Navicula cryptocephala var. veneta (Kütz.) Rabh. Pl. X, Fig. 9, Slide #324-1.

Critical reference: Patrick and Reimer 1966, p. 504, Pl. 48, Fig. 5.

Found in 39 lake samples and one marsh sample. Rare to uncommon in a great variety of lake habitats; no clear indication of habitat preference or periodicity. Because it was found only in a composite sample from the marsh, no comment can be made about its autecology there.

Navicula cuspidata (Kütz.) Kütz. var. cuspidata Pl. XI, Fig. 5, Slide #11-1.

Critical reference: Patrick and Reimer 1966, p. 464, Pl. 43, Fig. 9-10.

Rare in 10 marsh samples and two lake samples. Observed in the surface sediment at several marsh stations and in the marsh plankton at station X; no clear indication of periodicity. Rare in scrapings of rocks from 15-30 cm water at lake station 2 (22 July 1968) and 18 cm water at lake station 8 (29 April 1970).

Navicula cuspidata var. heribaudii Peragallo in Héribaud Pl. XI, Fig. 6, Slide #7-1.

Critical reference: Hustedt 1961, p. 60, Text fig. 1207a-d.

Rare in one lake sample; in rock scrapings from 15-30 cm water at station 2 (22 July 1968).

Navicula cuspidata var. major Meister Pl. XI, Fig. 1-1a, Slide #132-1.

Critical reference: Meister 1912, p. 134, Pl. 20, Fig. 10.

Rare in the surface sediment at marsh station VII in 30 cm water (21 July 1969).

Navicula decussis Østrup var. decussis Pl. XII, Fig. 11, Slide #86-4.

Critical reference: Patrick and Reimer 1966, p. 518, Pl. 49, Fig. 15.

Found only in lake samples. Rare in a variety of habitats; common only in the psammon at station 11 (23 November 1968). Observed April to November.

Navicula dicephala (Ehr.) Wm. Smith var. dicephala sensu Hustedt (1930) Pl. XI, Fig. 18, Slide #132-12.

Critical reference: Hustedt 1930, p. 302, Text fig. 526.

Found in one lake sample and one marsh sample. Rare in the surface sediment in 30 cm water at marsh station VII (22 July 1969) and rare in a composite sample from the lake.

It appears that Ehrenberg's specimens of Pinnularia dicephala, which have been designated in the literature as the type specimens for Navicula dicephala var. dicephala, do indeed belong to the genus Pinnularia (Patrick and Reimer, 1966, p. 599). However, my specimens and the specimens which recent authors have called N. dicephala var. dicephala belong to the genus Navicula and are to my knowledge without a name and a designated type. If a search of the literature does not reveal a legitimate name for this taxon, it will have to be named, described, and typified.

Navicula dicephala var. rostrata Mayer Pl. XI, Fig. 19 and 20, Slide #282-1 and #132-6 respectively.

Critical reference: Mayer 1917, p. 114, Pl. 1, Fig. 42a-b.

Rare in two surface sediment samples from the marsh; in 30 cm water at station VII (21 July 1969) and in 60 cm water at station XIII

(13 May 1970).

It appears that this name is not legitimate. See discussion above (under N. dicephala var. dicephala).

Navicula disjuncta Hust. var. disjuncta Pl. XII, Fig. 10, Slide #332-1.

Critical reference: Hustedt 1961, p. 143, Text fig. 1275a-e.

Observed only in a composite sample of the marsh diatoms (rare); no further comment is possible.

Navicula elata Gandhi var. elata Pl. XII, Fig. 7, Slide #303-1.

Critical reference: Gandhi 1970, p. 774, Pl. 3, Fig. 73.

Rare in rock scrapings from 15-30 cm water at lake station 16 (24 June 1970).

Navicula elata Gandhi is a later homonym to Navicula elata Leuduger-Fortmorel (1879) and this taxon must be renamed. To my knowledge, this is the first record of this taxon in United States waters.

Navicula explanata Hust. var. explanata Pl. XII, Fig. 8, Slide #39-2.

Critical reference: Patrick and Reimer 1966, p. 526, Pl. 50, Fig. 7.

Rare in three lake samples. An epiphyte on Salix sp. roots at station 9 (15 April 1970), in the surface sediment at station 8 (23 November 1968), and on dock pilings at station 10 (23 November 1968). Perhaps a cold-water form.

Navicula graciloides Mayer var. graciloides Pl. X, Fig. 22, Slide #80-3.

Critical reference: Patrick and Reimer 1966, Pl. 49, Fig. 9-10.

Found only in the surface sediment in 1.5 m water (including 61 cm ice covered by 13 cm snow) at lake station 12a (7 March 1969); rare.

Navicula heufleri Grun. var. heufleri Pl. X, Fig. 4, Slide #278-1.

Critical reference: Patrick and Reimer 1966, p. 515, Pl. 49, Fig. 6.

Observed in 12 marsh samples and one lake sample. Rare to uncommon in a variety of marsh habitats; no clear indication of periodicity. Rare in the surface sediment from 15 cm water at lake station 12 (23 November 1968). This taxon is very similar to small specimens of Navicula viridula var. argunensis and it may intergrade with that taxon.

Navicula lanceolata (Agardh) Kütz. var. lanceolata Pl. X, Fig. 6, Slide #54-2.

Critical reference: Patrick and Reimer 1966, p. 511, Pl. 48, Fig. 19-20.

Found in 21 marsh samples and 17 lake samples. Rare in a variety of lake habitats and rare to common in a variety of marsh habitats; no clear indication of habitat preference or seasonal periodicity in either of the study areas.

Navicula luzonensis Hust. var. luzonensis Pl. XI, Fig. 3, Slide #261-1.

Critical reference: Patrick and Reimer 1966, p. 492, Pl. 46, Fig. 24.

Rare in 14 lake samples and two marsh samples. In a variety of marsh habitats; no clear indication of habitat preference or periodicity. Epiphytic on Nymphaea tuberosa stems at lake station 2 (22 July 1968) and in the surface sediments from 2-5 cm water at lake station 2 (22 July 1968).

Navicula menisculus var. obtusa Hust. Pl. X, Fig. 11, Slide #132-7.

Critical reference: Hustedt 1938, p. 271, Pl. 20, Fig. 12-14.

In seven lake samples and one marsh sample. Rare in a variety of lake habitats except the psammon where it is uncommon (station 11; 23 November 1968); observed June to November. Rare on dock pilings at marsh station VIII (21 July 1969).

Navicula menisculus var. upsaliensis (Grun.) Grun Pl. X, Fig. 12, Slide #292-2.

Critical reference: Patrick and Reimer 1966, p. 519, Pl. 49, Fig. 17-18.

Rare in four lake samples and one marsh sample. In the surface sediment from 1.5 m water at lake station 12a (7 March 1969), in scrapings of rocks from 30 cm water at lake station 8 (10 November 1969), in the plankton at station 8 (6 January 1970), and in the psammon at lake station 10 (23 November 1968). In the marsh plankton at station X (10 June 1970).

Navicula minima Grunow var. minima sensu Grunow in Van Heurck Pl. X, Fig. 13, Slide #256-1.

Critical reference: Van Heurck 1880-1883, Pl. 14, Fig. 15.

Found only in rock scrapings from 30 cm water at lake station 8 (15 April 1970); rare.

My specimens of this taxon agree very well with Grunow's illustration of N. minima var. minima [Grunow, 1860, Pl. 2, Fig. 2 (as Navicula minutissima) and Grunow in Van Heurck, 1880-1883, Pl. 14, Fig. 15]. Modern authors (including Patrick and Reimer, 1966, and Hustedt, 1962) have included both this taxon which is distinctly rectangular in shape and has 24-26 striae in 10 microns, and the more finely striated lanceolate forms (see N. atomoides Grunow in Van Heurck, Pl. 14, Fig. 12) in their concept of N. minima var. minima. However, my populations of these two forms do not appear to intergrade. I have, therefore, elected to consider the rectangular forms as separate entities and have referred the more lanceolate forms, which may be identical to N. atomoides var.

atomoides, to N. nigrii var. nigrii below.

Navicula mutica Kütz. var. mutica Pl. X, Fig. 26 and 27, Slide #137-1 and #10-3 respectively.

Critical reference: Patrick and Reimer 1966, p. 454, Pl. 42, Fig. 2.

Found in six marsh samples and one lake sample. Rare in three epiphytic samples and three surface sediment samples in the marsh; observed April to July. Rare in the surface sediment from 3-8 cm water at lake station 3 (23 July 1968).

Navicula mutica var. undulata (Hilse) Grun. Pl. X, Fig. 29, Slide #117-2.

Critical reference: Patrick and Reimer 1966, p. 456, Pl. 42, Fig. 8.

Rare in grass squeezings from drainage ditch leading into the marsh (station III, 7 July 1969).

Navicula mutica Kütz. var. ? Pl. X, Fig. 28, Slide #132-5.

A single valve of this taxon was observed from the surface sediment in 30 cm water at marsh station VII (21 July 1969).

Navicula nigrii De Notaris var. nigrii Pl. XI, Fig. 17, Slide #258-1 and Pl. XVIII, Fig. 1-2.

Critical reference: Granetti 1968, p. 428, Text fig. 1-2.

In 28 marsh samples and seven lake samples. Rare to common in a variety of marsh habitats but particularly frequent in three samples; abundant on a plank submersed in 2-5 cm water at station I (15 April 1970), very abundant on a floating plank at station XIII (13 May 1970) and very abundant in scrapings from broken pieces of clay tile in 75 cm water in a drainage ditch leading into the marsh (station III, 7 July 1969). This taxon appears to tolerate highly enriched conditions since station III had 22.5 ppm nitrates and 0.2 ppm phosphates at the time of collection. Rare to uncommon in a variety of lake habitats. No clear indication of seasonal periodicity in either study area.

Electron micrographs of my specimens agree very well with the electron micrographs of De Notaris' type material (in Granetti, 1968) and there is no doubt that my specimens are identical to De Notaris' Navicula nigrii var. nigrii. Granetti (1968) stated that N. nigrii De Notaris var. nigrii and Navicula minima Grunow var. minima are identical. However, as I stated earlier (see N. minima var. minima), the specimens of N. minima var. minima which Grunow has illustrated are rectangular in shape and have about 24-26 striae in 10 microns while my specimens of this taxon and those illustrated by Granetti (1968) are always more lanceolate and more finely striated (my specimens vary from 28 striae in 10 microns in the larger specimens to 36 striae in 10 microns in the smaller specimens). For these reasons, I have rejected Granetti's contention that N. nigrii var. nigrii and N. minima var. minima are synonyms. N. nigrii var. nigrii appears to more closely resemble Navicula atomoides Grunow var. atomoides (Grunow in Van Heurck 1880-1883, Pl. 14, Fig. 12) which, as I have already mentioned, I do not believe should be synonomized with N. minima var. minima.

This taxon is variable in stria count, shape of the central area, and shape of the valve. I have illustrated a series of specimens which represent the variations found in my samples.

Navicula nyassensis f. minor O. Müller Pl. XI, Fig. 10, Slide #48-1.

Critical reference: Müller 1911, p. 86, Pl. 1, Fig. 6.

Rare in one lake sample and one marsh sample; in the psammon at lake station 11 (23 November 1968) and an epiphyte on Potamogeton pectinatus at marsh station X (22 July 1970).

Navicula oblonga Kütz. var. oblonga Pl. X, Fig. 30, Slide #179-3.

Critical reference: Hustedt 1930, p. 307, Text fig. 550.

Rare in rock scrapings from just below water surface at lake station 8 (15 September 1969).

Navicula paludosa Hust. var. paludosa Pl. XI, Fig. 22, Slide #279-5.

Critical reference: Foged 1964, p. 93, Pl. 10, Fig. 4.

A rare epiphyte in two marsh samples; in grass squeezings at station XII (13 May 1970) and in squeezings of Utricularia vulgaris at station VI (24 June 1970).

Navicula pelliculosa (Bréb.) Hilse var. pelliculosa Pl. XVIII, Fig. 8, Slide #258-2 (Hyrax mounted TEM grid).

Critical reference: Hustedt 1962, p. 172, Text fig. 1305.

Rare in two marsh samples. In scrapings of a plank submersed in 2-5 cm water at station I (15 April 1970) and in the plankton at station X (4 August 1969).

Navicula peratomus Hust. var. peratomus Pl. XVIII, Fig. 5, Slide #332-1.

Critical reference: Hustedt 1962, p. 171, Text fig. 1304a.

Found only in a composite sample from the marsh. No further autecological statement can be made.

Navicula placentula (Ehr.) Kütz. var. placentula Pl. XII, Fig. 5, Slide #303-1.

Critical reference: Patrick and Reimer 1966, p. 523, Pl. 50, Fig. 1.

Rare in three lake samples and one marsh sample. In scrapings of rocks from 15-30 cm water at lake station 2 (22 July 1968) and from 15-30 cm water at lake station 16 (24 June 1970) and in the psammon at lake station 11 (23 November 1968). Epiphytic on Potamogeton pectinatus at marsh station X (22 July 1970).

Navicula placentula var. rostrata Mayer   Pl. XII, Fig. 6, Slide #54-3.

Critical reference: Mayer 1918, p. 125, Pl. 3, Fig. 27.

Rare in squeezings of Potamogeton pectinatus from 30 cm water at marsh station I (23 November 1968).

Navicula platycephala O. Müller var. platycephala   Pl. XI, Fig. 11, Slide #48-3.

Critical reference: Müller 1911, p. 84, Pl. 1, Fig. 12.

Rare in the psammon from lake station 11 (23 November 1968).

Navicula pseudatomus Lund var. pseudatomus   Pl. XVIII, Fig. 6, Slide #332-1.

Critical reference: Lund 1946, p. 74, Text fig. 6k-w.

Rare in six marsh samples. In two epiphytic samples, in two plank scrapings and in two plankton samples; observed April to December.

Navicula pupula Kütz. var. pupula   Pl. XI, Fig. 7, Slide #54-2.

Critical reference: Patrick and Reimer 1966, p. 495, Pl. 47, Fig. 7.

Found in 11 marsh samples and three lake samples. Rare to uncommon in a variety of marsh habitats, but abundant in the surface sediment from 13-15 cm water at marsh station I (4 August 1969); observed May to December. Rare in a sample of Spirogyra sp. on splash zone of rocks at lake station 12 (23 November 1968)--I have been unable to find any epiphytes on the Spirogyra sp. itself and believe that the diatoms in this sample have been trapped there. Rare on Cladophora sp. at lake station 16 (24 June 1970) and rare in the surface sediment at station 8 (22 July 1970).

Navicula pupula var. rectangularis (Greg.) Grun. Pl. XI, Fig. 8, Slide #132-3.

Critical reference: Patrick and Reimer 1966, p. 497, Pl. 47, Fig. 12.

In 11 marsh samples and two lake samples. Rare to uncommon in a variety of marsh habitats, but most frequently encountered in the surface sediment samples. Observed April to December in the marsh. Rare in the surface sediment from 15 cm water at lake station 12 (23 November 1968) and from 4.0 m water at lake station 14 (7 March 1969).

Navicula pupula Kütz. var. ? Pl. XI, Fig. 9, Slide #303-2.

Rare in three lake samples. An epiphyte on Myriophyllum sp. at station 2 (23 November 1968) and on Cladophora sp. at station 16 (24 June 1970); on rocks in 15-30 cm water at station 16 (24 June 1970).

This taxon appears to be closely related to Navicula pupula var. pupula from which it differs in that it lacks expanded terminal nodules and thickened end striae. I have searched the literature and believe this taxon to be new to science.

Navicula radiosa Kütz. var. radiosa Pl. X, Fig. 14, Slide #92-1.

Critical reference: Patrick and Reimer 1966, p. 509, Pl. 48, Fig. 15.

Rare to uncommon in 31 lake samples, but not found in the marsh. Found in a great variety of habitats with no clear indication of preference; observed April to November, but not in winter samples.

Navicula radiosa var. parva Wallace Pl. X, Fig. 18, Slide #256-2.

Critical reference: Patrick and Reimer 1966, p. 510, Pl. 48, Fig. 16.

Rare in two epilithic samples from the lake, at station 15 in 60 cm water (7 July 1969) and at station 8 in 30 cm water (15 April 1970).

Navicula radiosa var. tenella (Bréb. ex Kütz.) Grun. Pl. X, Fig. 15-17, Slide #125-1.

Critical reference: Patrick and Reimer 1966, p. 510, Pl. 48, Fig. 17.

Found in 66 lake samples and 11 marsh samples. In a great variety of lake habitats with no clear indication of preference or of seasonal periodicity; rare to abundant. In three epiphytic samples and eight plankton samples in the marsh; no clear indication of periodicity; rare to uncommon.

Navicula reinhardtii (Grun.) Grun. var. reinhardtii Pl. X, Fig. 24, Slide #246-1.

Critical reference: Patrick and Reimer 1966, p. 517, Pl. 49, Fig. 12.

Rare in five lake samples and one marsh sample. In scrapings of rocks from 30 cm water at lake station 8 (17 March 1970 and 24 June 1970), from 30 cm water at station 8a (15 April 1970), and from 15-30 cm water at station 16 (24 June 1970); in the psammon at lake station 11 (23 November 1968). In the surface sediment at marsh station X (29 April 1970).

Navicula salinarum var. intermedia (Grun.) P. T. Cleve Pl. X, Fig. 7, Slide #96-2.

Critical reference: Patrick and Reimer 1966, p. 503, Pl. 48, Fig. 2.

Observed in 50 lake samples and four marsh samples. Rare to common in a variety of lake habitats with no clear indication of preference; no clear indication of seasonal periodicity. A rare epiphyte on *Najas* sp. at marsh station I (23 July 1968) and on *Potamogeton* sp. at station II (24 June 1969); rare in the surface sediment at station X (29 April 1970); rare in scrapings of dock pilings at station VIII (21 July 1969).

Navicula schoenfeldi Hust. var. *schoenfeldi* Pl. XI, Fig. 28, 29 and 30, Slide #115-1, #215-1 and #306-1 respectively.

Critical reference: Hustedt 1950, p. 353, Pl. 37, Fig. 31-37.

Rare in 10 lake samples from a variety of habitats; no clear indication of habitat preference or periodicity.

The specimen I have illustrated in Fig. 30 is probably identical to *Navicula lagerstedti* var. *palustris* f. *minores* (Hustedt, 1950, Pl. 37, Fig. 31-33). Hustedt (1950, p. 354) stated that his specimens approach *N. schoenfeldi*. I believe that specimens of this taxon are really only small specimens of *N. schoenfeldi* var. *schoenfeldi* and have considered them as such in this paper. Foged (1964) also considered this taxon to be closely related to *N. schoenfeldi* var. *schoenfeldi* since he labeled his specimens "*N. schoenfeldi* forma." It differs from the larger specimens of *N. schoenfeldi* var. *schoenfeldi* only in that it lacks the alternately shortened striae about the central area.

Navicula seminulum Grun. var. *seminulum* Pl. XI, Fig. 16, Slide #284-1.

Critical reference: Hustedt 1962, p. 241, Text fig. 1367.

Rare to uncommon in nine marsh samples and rare in six lake samples. In a variety of marsh habitats, but most frequently encountered in epiphytic samples; no clear indication of seasonal periodicity in the marsh. In a variety of lake habitats with no clear indication of preference; observed July to November.

Navicula simplex Krasske var. simplex Pl. XI, Fig. 14 and 15, Slide #283-4 and #283-5 respectively.

Critical reference: Hustedt 1934 in Schmidt et al. 1874-1959, Pl. 399, Fig. 37-41.

Rare in squeezings of dead and decaying Typha latifolia and Scirpus sp. at marsh station XIV (13 May 1970).

Navicula stroesei (Østrup) A. Cleve var. stroesei Pl. XII, Fig. 1 and 2, Slide #246-1 and #48-2 respectively.

Critical reference: Cleve-Euler 1953, p. 122, Fig. 743a-e.

Rare in two lake samples; in the psammon at station 11 (23 November 1968) and in scrapings of rocks from 1 m water at station 8 (17 March 1970).

Navicula subarvensoides Archibald var. subarvensoides Pl. XVIII, Fig. 7, Slide #278-1.

Critical reference: Archibald 1966, p. 262, Pl. 1, Fig. 39.

Rare to uncommon in six marsh samples; most frequently encountered as an epiphyte (four samples). Observed in May and July.

To my knowledge, this is the first United States record of this taxon.

Navicula subrotundata Hust. var. subrotundata Pl. XI, Fig. 4, Slide #325-1.

Critical reference: Hustedt 1962, p. 272, Text fig. 1402a-m.

Rare in three lake samples. An epiphyte on Chara sp. at station 11 (24 June 1969) and in the surface sediment from 1.8 m water and 3 m water at station 8 (both 22 July 1970).

Navicula tantula Hust. var. tantula Pl. X, Fig. 25, Slide #119-1.

Critical reference: Hustedt 1962, p. 250, Text fig. 1375a-d.

Rare to uncommon in eight marsh samples and rare in two lake samples. Found in surface sediment and epiphytic samples from the marsh; most frequently encountered as an epiphyte (six samples). Observed in the marsh from May to July. In a sample of Spirogyra sp. on splash zone of rocks at lake station 12 (23 November 1968), but I have been unable to find any epiphytes on the Spirogyra sp. itself and believe that the diatoms in this sample have simply been trapped there. Rare in the surface sediment from 1.5 m water at lake station 12a (7 March 1969).

Navicula tripunctata (O. Müller) Bory var. tripunctata Pl. X, Fig. 21, Slide #256-2.

Critical reference: Patrick and Reimer 1966, p. 513, Pl. 49, Fig. 3.

Rare in three lake samples and one marsh sample. On rocks from 56 cm water (including 10 cm ice covered with 2.5 cm snow) and from 30 cm water at lake station 8 (6 March 1969 and 15 April 1970 respectively); in the surface sediment from 2-5 cm water at lake station 2 (22 July 1968). In the surface sediment from 60 cm water at marsh station XIII (13 May 1970).

Navicula tuscula Ehr. var. tuscula Pl. XII, Fig. 3, Slide #253-1.

Critical reference: Patrick and Reimer 1966, p. 539, Pl. 52, Fig. 7.

Rare in scrapings of rocks from 30 cm water at lake station 8a (15 April 1970) and rare in the plankton at lake station 8 (4 August 1969).

Navicula tuscula f. minor Hust. Pl. XII, Fig. 4, Slide #215-1.

Critical reference: Hustedt 1930, Text fig. 553.

Rare in four lake samples from lake station 8; an epiphyte on Heteranthera dubia (4 August 1969), in the surface sediment from 1.8 m water (22 July 1970), and in scrapings of rocks from 30 cm water (10 November 1969 and 10 June 1970).

Navicula vanheurckii Patr. var. vanheurckii Pl. XI, Fig. 2, Slide #226-2.

Critical reference: Patrick and Reimer 1966, p. 491, Pl. 46, Fig. 22.

Rare in six lake samples. In one surface sediment sample, three epilithic samples and one plankton sample from station 8. In the psammon at station 11. Observed January to November.

Navicula viridula var. argunensis Skvortzow Pl. X, Fig. 1-3, Slide #137-2, #56-1 and #132-8 respectively.

Critical reference: Skvortzow 1938, p. 408, Pl. 1, Fig. 9 and 33.

Rare to common in 25 marsh samples and 12 lake samples. In a variety of habitats from both study areas with no clear indication of preference or seasonal periodicity.

Navicula vulpina Kütz. var. vulpina Pl. X, Fig. 19, Slide #80-1.

Critical reference: Patrick and Reimer 1966, p. 531, Pl. 50, Fig. 19.

Rare in the surface sediment from 1.5 m water (including 61 cm ice covered by 13 cm snow) at lake station 12a (7 March 1969).

Navicula wittrockii (Lagerstedt) A. Cleve-Euler var. wittrockii Pl. XI, Fig. 12, Slide #132-1.

Critical reference: Hustedt 1961, p. 124, Text fig. 1256.

Rare in five marsh samples and one lake sample. In three surface sediment samples from marsh stations VII, XI and XIV (21 July 1969, 27 October 1969 and 13 May 1970 respectively), epiphytic on stems of

Nymphaea tuberosa at station X (22 July 1970) and in the marsh plankton at station X (15 April 1970). In surface sediment from 4.0 m water (including 61 cm ice covered by 15 cm snow) at lake station 14 (7 March 1969).

Navicula sp. #16 Pl. XI, Fig. 13, Slide #80-7.

One specimen of this taxon appeared in surface sediment from 1.5 m water (including 61 cm ice covered by 13 cm snow) at lake station 12a (7 March 1969).

Neidium Pfitzer

Neidium affine var. capitata Mölder Pl. VI, Fig. 1 and 2, Slide #321-3 and #321-4 respectively.

Critical references: Foged 1960, p. 14, Text fig. 11.

Rare in two marsh samples; epiphytic on Potamogeton pectinatus at station X (22 July 1970) and in the surface sediment from 30 cm water at station VII (21 July 1969).

Neidium affine var. tenuirostris Mayer Pl. VI, Fig. 3, Slide #132-5.

Critical reference: Stoermer 1963b, p. 2, Pl. 1, Fig. 5-6.

Rare in the bottom sediment in 30 cm water at marsh station VII (21 July 1969).

Neidium affine var. undulatum (Grun.) P. T. Cleve Pl. VI, Fig. 4, Slide #321-4.

Critical reference: Patrick and Reimer 1966, p. 393, Pl. 35, Fig. 7.

A rare epiphyte on Potamogeton pectinatus at marsh station X (22 July 1970) and rare in surface sediment from 60 cm water at marsh station XIII (13 May 1970).

Neidium bisulcatum var. baicalense (Skvortzow & Meyer) Reimer Pl. VI, Fig. 14, Slide #282-2.

Critical reference: Patrick and Reimer 1966, p. 397, Pl. 36, Fig. 6.

Rare in surface sediment from 60 cm water at marsh station XIII (13 May 1970).

Neidium decens (Pantocsek) Stoermer var. ? Pl. VI, Fig. 7, Slide #321-2.

A rare epiphyte on Potamogeton pectinatus at marsh station X (22 July 1970).

This taxon varies from the nominate variety in that its ends are more narrowed and more sharply pointed.

Neidium distincte-punctatum Hust. var. distincte-punctatum Pl. VI, Fig. 5 and 6, Slide #304-1 and #80-1 respectively.

Critical reference: Stoermer 1963b, p. 3, Pl. 1, Fig. 7.

Rare on Cladophora sp. at lake station 16 (24 June 1970) and in surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969).

Neidium dubium (Ehr.) P. T. Cleve var. dubium Pl. VI, Fig. 8, Slide #89-2.

Critical reference: Patrick and Reimer 1966, p. 404, Pl. 37, Fig. 5.

Rare in scrapings from rocks in 30 cm water at lake station 11 (24 June 1969).

Neidium hankensis Skvortzow var. hankensis Pl. VI, Fig. 9, Slide #138-2.

Critical reference: Stoermer 1963b, p. 4, Pl. 1, Fig. 1-3.

Rare in four marsh samples and one lake sample. In a collection of algae and debris from the bottom in 30 cm water at marsh station IX (21 July 1969), in the surface sediments at marsh stations VII and I (21

July 1969 and 4 August 1969 respectively), and in the plankton at station X (8 July 1970). In the surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969).

Neidium hankensis var. elongata Skvortzow   Pl. VI, Fig. 10 and 11, Slide #282-2 and #132-9 respectively.

Critical reference: Stoermer 1963b, p. 4, Pl. 1, Fig. 4.

Rare in three marsh samples. In a collection of algae and debris from the bottom in 30 cm water at station IX (21 July 1969); in surface sediment from 30 cm water at station VII (21 July 1969) and from 60 cm water at station XIII (13 May 1970).

Neidium hitchcockii (Ehr.) P. T. Cleve var. hitchcockii   Pl. VI, Fig. 12, Slide #80-2.

Critical reference: Patrick and Reimer 1966, p. 395, Pl. 36, Fig. 2.

Rare in surface sediment from 1.5 m water (including 61 cm ice covered by 13 cm snow) at lake station 12a (7 March 1969).

Neidium iridis (Ehr.) P. T. Cleve var. iridis   Pl. VI, Fig. 13 and 19, Slide #89-2 and #132-12 respectively.

Critical reference: Patrick and Reimer 1966, p. 386, Pl. 34, Fig. 1.

Rare in two lake samples and one marsh sample. In the surface sediment in 4.0 m water (including 61 cm ice covered with 15 cm snow) at lake station 14 (7 March 1969) and in scrapings of rocks from 30 cm water at lake station 11 (24 June 1969). In the surface sediment in 30 cm water at marsh station VII (21 July 1969).

Neidium iridis var. amphigomphus (Ehr.) Mayer   Pl. VI, Fig. 15, Slide #57-1.

Critical reference: Patrick and Reimer 1966, p. 387, Pl. 34, Fig. 2.

Rare in scrapings from rocks in 7-8 cm water at lake station 2 (23 November 1968).

Neidium iridis var. *amphigomphus* f. *rostrata* Hust. Pl. VI, Fig. 16, Slide #198-1.

Critical reference: Hustedt 1942b, p. 92, Text fig. 176-177.

Rare in surface sediment from 90 cm water at marsh station XI (27 October 1969).

Neidium temperei Reimer var. *temperei* Pl. VI, Fig. 18, Slide #80-5.

Critical reference: Patrick and Reimer 1966, p. 406, Pl. 37, Fig. 9.

Rare in surface sediment from 1.5 m water (including 61 cm ice covered by 13 cm snow) at lake station 13 (6 March 1969) and rare in surface sediment from 90 cm water at marsh station XI (27 October 1969).

Neidium sp. #2 Pl. VI, Fig. 17, Slide #6-1.

A rare epiphyte on *Scirpus validus* at lake station 2 (22 July 1968).

Nitzschia Hassall nom. cons.

Nitzschia acicularioides Hust. var. ? Pl. XV, Fig. 8, Slide #322-1.

Critical reference: Hustedt 1959a, p. 415, Text fig. 22-24.

Rare in three lake samples and one marsh sample. In a sample of *Spirogyra* sp. from splash zone of rocks at lake station 12 (23 November 1968)--probably simply trapped there since I was unable to find any epiphytes on the *Spirogyra* sp. itself; in surface sediment from 3-8 cm water at lake station 10 (23 July 1968); in scrapings of rocks from 30-40 cm water at lake station 8 (24 June 1970). An epiphyte on stems of *Nymphaea tuberosa* at marsh station X (22 July 1970).

Hustedt (1959a) stated, in his description of the nominate variety that the striae are inconspicuous. Since the striae on my specimens are resolvable (36-38 in 10 microns), I feel that a new variety should be erected.

Nitzschia acicularis (Kütz.) Wm. Smith var. acicularis Pl. XVI, Fig. 2, Slide #283-5.

Critical reference: Hustedt 1930, p. 423, Text fig. 821.

Rare to uncommon in eight marsh samples and rare to common in seven lake samples. Best development in the plankton in both study areas. Observed January to November; no clear indication of periodicity.

Nitzschia acuta Hantzsch var. acuta Pl. XV, Fig. 2, Slide #156-1.

Critical reference: Hustedt 1930, p. 412, Text fig. 790.

Rare in three lake samples. Epiphytic on Heteranthera dubia at station 8 (4 August 1969), in surface sediment from 3.0 m water at station 8 (22 July 1970), and in scrapings of rocks from 30 cm water at station 8 (10 June 1970).

Nitzschia amphibia Grun. var. amphibia Pl. XIV, Fig. 11, Slide #4-1.

Critical reference: Hustedt 1930, p. 414, Text fig. 793.

A very prominent marsh diatom; found in 83% of all marsh samples (53 samples) and 90% of all non-plankton samples (37 samples). Uncommon to very abundant in most marsh samples (rare in only a few) and found on a great variety of substrates with no clear indication of preference or seasonal periodicity. Rare to uncommon in 29 lake samples with no clear indication of habitat preference or seasonal periodicity.

Nitzschia angustata (Wm. Smith) Grun. var. angustata Pl. XIV, Fig. 9, Slide #58-1.

Critical reference: Hustedt 1930, p. 402, Text fig. 767.

Rare in seven lake samples and three marsh samples. In a variety of lake habitats, no clear indication of preference. Observed March to November in the lake. In the surface sediment in 60 cm water at marsh station XIII (13 May 1970) and in two plankton samples from marsh station X (18 August 1969 and 13 May 1970).

Nitzschia angustata var. acuta Grun. Pl. XIV, Fig. 8, Slide #113-2.

Critical reference: Hustedt 1930, p. 402, Text fig. 768.

Rare in 13 lake samples; in a variety of habitats, but most frequently encountered as an epiphyte on a variety of plants (9 samples). No clear indication of periodicity.

Nitzschia capitellata Hust. var. capitellata Pl. XV, Fig. 9-10, Slide #27-2.

Critical reference: Hustedt 1922 in Schmidt et al. 1874-1959, Pl. 348, Fig. 57-59.

Rare to common in nine marsh samples and rare in five lake samples. Prefers an epiphytic existence in the marsh where it was observed from April to August. In a variety of lake habitats, but no clear indication of preference; observed from July to November.

Nitzschia commutata Grun. var. commutata Pl. XIV, Fig. 15, Slide #279-4.

Critical reference: Hustedt 1930, p. 405, Text fig. 774.

Rare in two marsh samples. Epiphytic on grasses in 15 cm water at station XII (13 May 1970) and in surface sediment from 90 cm water at station XI (27 October 1969).

Nitzschia debilis (Arnott) Grun. var. debilis Pl. XVI, Fig. 4, Slide #279-5.

Critical reference: Van Heurck 1880-1883, Pl. 57, Fig. 19-21.

Rare in squeezings of grasses in 15 cm water at marsh station XII (13 May 1970).

Nitzschia dissipata (Kütz.) Grun. var. dissipata Pl. XVI, Fig. 3, Slide #179-2.

Critical reference: Hustedt 1930, p. 412, Text fig. 789.

A prominent lake form. Rare to common in 62 lake samples and rare in five marsh samples. In a great variety of lake habitats with no clear indication of preference; no clear indication of seasonal periodicity. In one epiphytic, one surface sediment, and three plankton samples from the marsh; observed April to December.

Nitzschia elegans Hust. var. elegans Pl. XVI, Fig. 7, Slide #6-1.

Critical reference: Hustedt 1956, p. 127, Text fig. 71-73.

Rare to uncommon in five lake samples and rare in three marsh samples. No clear indication of habitat preference in either study area. Observed in the lake only during the month of July and in the marsh only during April and July.

Nitzschia fonticola Grun. in Van Heurck var. fonticola Pl. XV, Fig. 13, Slide #295-1.

Critical reference: Hustedt 1949a, p. 142, Pl. 13, Fig. 75-83.

Rare to uncommon in eight lake samples and rare in three marsh samples. In a variety of lake habitats; no clear indication of habitat preference or periodicity. Epiphytic on Drepanocladus aduncus at marsh station XII (13 May 1970) and in two marsh plankton samples from station X (15 April 1970 and 13 May 1970).

Nitzschia frustulum (Kütz.) Rabh. var. frustulum Pl. XV, Fig. 16, Slide #138-4.

Critical reference: Hustedt 1930, p. 414, Text fig. 795.

Rare to uncommon in 11 marsh samples; in five epiphytic samples (on a variety of plants) and six surface sediment samples. Observed from May to August.

Nitzschia gracilis Hantzsch var. gracilis Pl. XVI, Fig. 5, Slide #333-1.

Critical reference: Hustedt 1930, p. 416, Text fig. 794.

Rare in a composite sample from the lake. No further autecological comment can be made.

I have seen isotype material of this taxon and it agrees well with my specimens.

Nitzschia graciloides Hust. var. graciloides Pl. XVI, Fig. 6, Slide #226-2.

Critical reference: Hustedt 1959b, p. 95, Pl. 1, Fig. 4-5.

Rare in four lake samples; epiphytic on Elodea sp. at station 12 (23 November 1968), in the surface sediments from station 12 and 8 (23 November 1968 and 22 July 1970 respectively) and in scrapings from rocks in 45 cm water (including 4 cm ice covered with 2.5 cm snow) at station 8 (6 January 1970).

This name is a later homonym to Nitzschia graciloides Hustedt (1953). Furthermore, Gandhi (1970) has also described a Nitzschia graciloides.

Nitzschia holsatica Hust. var. holsatica Pl. XIV, Fig. 13-14, Slide #283-6.

Critical reference: Hustedt 1930, p. 416, Text fig. 803.

Rare to common in 21 marsh samples and rare to uncommon in nine marsh samples. Found in a variety of habitats from both study areas, but appears to develop best in the plankton. No clear indication of periodicity.

This taxon may be more abundant than the data indicate since I have discovered that some of the frustules are destroyed by peroxide cleaning.

Nitzschia hungarica Grun. var. hungarica Pl. XIV, Fig. 16, Slide #321-1.

Critical reference: Hustedt 1930, p. 401, Text fig. 766.

Rare in three marsh samples; epiphytic on Potamogeton pectinatus at station X (22 July 1970), in surface sediment from 13-15 cm water at station I (4 August 1969), and in the plankton at station X (27 October 1969).

Nitzschia lauenburgiana Hust. var. lauenburgiana Pl. XV, Fig. 5-5a, Slide #246-2.

Critical reference: Hustedt 1950, p. 402, Pl. 40, Fig. 6-7, 9-11.

Rare in eight lake samples; no clear indication of habitat preference or periodicity.

Nitzschia legleri Hust. var. legleri Pl. XV, Fig. 15, Slide #70-1.

Critical reference: Hustedt 1959c, p. 437, Text fig. 18-20.

Rare in three lake samples and one marsh sample. In the surface sediments at lake stations 12 (23 November 1968), 2 (91 cm water including 38 cm ice covered by 15 cm snow; 6 March 1969), and 12a (1.5 m water including 61 cm ice covered by 13 cm snow; 7 March 1969). An epiphyte on Utricularia vulgaris at marsh station VI (24 June 1970).

Nitzschia linearis (Agardh) Wm. Smith var. linearis Pl. XV, Fig. 3-3a, Slide #9-1.

Critical reference: Hustedt 1921 in Schmidt et al. 1874-1959, Pl. 334, Fig. 22-24.

Rare in 12 lake samples and rare to uncommon in nine marsh samples. In a variety of habitats from both study areas with no clear indication of preference; no clear indication of seasonal periodicity.

Nitzschia palea (Kütz.) Wm. Smith var. palea Pl. XV, Fig. 19, Slide #136-3.

Critical reference: Hustedt 1930, p. 416, Text fig. 801.

Rare to very abundant in 25 marsh samples and rare to uncommon in eight lake samples. In a variety of marsh habitats, but was common to very abundant only as an epiphyte on a variety of plants; observed during all seasons except winter when sampling was not possible. In a variety of lake habitats with no clear indication of preference; observed June to November.

Nitzschia palea var. debilis (Kütz.) Grun. Pl. XV, Fig. 21, Slide #27-1.

Critical reference: Van Heurck 1880-1883, Pl. 69, Fig. 28-29.

Rare to common in six marsh samples and rare in four lake samples. Best development as an epiphyte on a variety of plants in both study areas. Observed May to July in the marsh and in August and November in the lake.

I have seen Van Heurck material of this taxon (Van Heurck Exsiccata, Slide #428, Academy of Natural Sciences of Philadelphia) and found his specimens to agree well with mine. Specimens of this taxon are more coarsely striated (32 in 10 microns) and somewhat more heavily silicified than those of the nominate variety.

Nitzschia palea var. tropica Hust. Pl. XV, Fig. 20, Slide #332-1.

Critical reference: Hustedt 1949a, p. 147, Pl. 13, Fig. 26-29.

Rare in a composite sample from the marsh. No further ecological comment can be made.

Nitzschia paleoides Hust. var. paleoides Pl. XVI, Fig. 1, Slide #11-1.

Critical reference: Hustedt 1938, p. 483, Pl. 41, Fig. 11.

Rare in six marsh samples and two lake samples. Seemed to prefer plant substrates (variety of plants) in the marsh, but also appeared in one sediment sample and in scrapings of a plank. Epiphytic on Vallisneria americana at lake station 3 (23 July 1968) and in surface sediment from 2-5 cm water at lake station 2 (22 July 1968).

Nitzschia parvula var. terricola Lund Pl. XIV, Fig. 7, Slide #279-4.

Critical reference: Lund 1946, p. 97, Text fig. 14a-i.

A rare epiphyte on grasses in 15 cm water at marsh station XII (13 May 1970).

Nitzschia philippinarum Hust. var. philippinarum Pl. XV, Fig. 7, Slide #283-2.

Critical reference: Hustedt 1942b, p. 137, Text fig. 322-330.

Rare in three marsh samples. An epiphyte on Drepanocladus aduncus at station XII (13 May 1970) and on dead and decaying Typha latifolia and Scirpus sp. at station XV (13 May 1970). In scrapings from a plank submersed in 2-5 cm water at station I (15 April 1970).

Nitzschia pilum Hust. var. pilum Pl. XV, Fig. 11, Slide #27-3.

Critical reference: Hustedt 1957, p. 353, Text fig. 58-62.

Rare in seven marsh samples and rare to uncommon in six lake samples. Epiphytic on a variety of plants and in three surface sediment samples from the marsh. Epiphytic on a variety of plants, in two surface sediment samples, and in one epilithic sample from the lake. Observed April to August in the marsh and April to November in the lake.

Nitzschia recta Hantzsch in Rabh. var. recta   Pl. XIV, Fig. 17, Slide #4-1.

Critical reference: Hustedt 1930, p. 411, Text fig. 785.

Rare in 10 lake samples. In a variety of habitats with no clear indication of preference; observed March to November.

Nitzschia sigmoidea (Nitzsch) Wm. Smith var. sigmoidea   Pl. XV, Fig. 1-1a, Slide #66-1.

Critical reference: Hustedt 1930, p. 419, Text fig. 810.

Rare in surface sediment from 1.1 m water (including 60 cm ice covered with 15 cm snow) at lake station 3 (6 March 1969).

Nitzschia subrostrata Hust. var. subrostrata   Pl. XV, Fig. 18, Slide #4-3.

Critical reference: Huber-Pestalozzi 1942, p. 475, Text fig. 575b.

Rare to common in five marsh samples and rare to uncommon in three lake samples. In a variety of habitats with no clear indication of preference. No clear indication of periodicity.

Nitzschia subrostratoides Cholnoky var. subrostratoides   Pl. XV, Fig. 12, Slide #308-1.

Critical reference: Cholnoky 1966, p. 59, Pl. 6, Fig. 171-173.

A rare epiphyte on Utricularia vulgaris at marsh station VI (24 June 1970).

Nitzschia subtilioides Hust. var. subtilioides   Pl. XV, Fig. 4-4a, Slide #308-1.

Critical reference: Hustedt 1959c, p. 438, Text fig. 9-13.

Rare to uncommon in three marsh samples and rare in one lake sample. An epiphyte on Utricularia vulgaris at marsh station VI (24 June 1970) and in two plankton samples from marsh station X (4 August 1969 and

18 August 1969). In surface sediment from 15 cm water at lake station 12 (23 November 1968).

Nitzschia tenuis Grun. var. tenuis Pl. XV, Fig. 6-6a, Slide #9-1.

Critical reference: Hustedt 1950, p. 404, Pl. 40, Fig. 1-5 and 8.

Rare in three lake samples. Epiphytic on Potamogeton pectinatus at station 2 (22 July 1968), in the surface sediments in a shallow pool at station 9 (23 July 1968) and in 3.0 m water at station 8 (22 July 1970).

Nitzschia tropica Hust. var. tropica Pl. XV, Fig. 17, Slide #283-2.

Critical reference: Hustedt 1949a, p. 147, Pl. 11, Fig. 34-48.

Rare to abundant in 58 lake samples and rare to common in 34 marsh samples. In a great variety of habitats from both study areas with no clear indication of preference. No clear indication of periodicity.

Nitzschia valdestriata Aleem & Hustedt var. valdestriata Pl. XIV, Fig. 12, Slide #88-1.

Critical reference: Hustedt 1957, p. 355, Text fig. 76-80.

Rare in squeezings of Cladophora sp. from 15 cm water at lake station 11 (24 June 1969).

Nitzschia sp. #4 Pl. XIV, Fig. 10, Slide #4-3.

Rare in two lake samples and two marsh samples. In surface sediment from 2-5 cm water at lake station 2 (22 July 1968) and in the plankton at lake station 8 (15 September 1969). In two surface sediment samples from marsh stations XIII and XIV (both 13 May 1970).

Nitzschia sp. #12 Pl. XV, Fig. 22, Slide #284-1.

Rare in three marsh samples. On dead and decaying Typha latifolia and Scirpus sp. at station XIV (13 May 1970), epiphytic on Potamogeton pectinatus at station X, and in the surface sediment at station XIV (13 May 1970).

Nitzschia sp. #13 Pl. XV, Fig. 14, Slide #332-1.

Rare in six plankton samples from marsh station X (August to October 1969 and July 1970).

Opephora Petit

Opephora martyi Héribaud var. martyi Pl. II, Fig. 1, Slide #11-4.

Critical reference: Patrick and Reimer 1966, p. 115, Pl. 3, Fig. 3.

Rare in 12 lake samples. Found in a variety of habitats, but most frequently encountered from surface sediments. No clear indication of seasonal periodicity.

Pinnularia Ehr. nom. cons. non Lindley & Hutton

Pinnularia acrosphaeria Wm. Smith var. acrosphaeria Pl. VII, Fig. 19, Slide #279-1.

Critical reference: Patrick and Reimer 1966, p. 623, Pl. 60, Fig. 2-3.

Rare in three marsh samples. Epiphytic on Lemna trisulca and L. minor at station VI (4 August 1969) and on grasses at station XII (13 May 1970); in surface sediment from 30 cm water at station VII (21 July 1969).

Pinnularia biceps Greg. var. biceps Pl. VII, Fig. 20, Slide #280-1.

Critical reference: Cleve-Euler 1955, p. 62, Fig. 1088 a, c and d (as P. biceps α typica A. Cleve).

Rare in the surface sediment in 60 cm water at marsh station XII

(13 May 1970).

Pinnularia borealis Ehr. var. borealis Pl. VII, Fig. 12, Slide #263-2.

Critical reference: Patrick and Reimer 1966, p. 618, Pl. 58, Fig. 13.

Rare in scrapings from rocks in 60 cm water at lake station 8a (29 April 1970).

Pinnularia brebissonii (Kütz.) Rabh. var. brebissonii Pl. VII, Fig. 13, Slide #185-1.

Critical reference: Patrick and Reimer 1966, p. 614, Pl. 58, Fig. 6.

Rare to uncommon in nine marsh samples and rare in two lake samples. Encountered most frequently in surface sediment samples. Observed April to November.

Pinnularia brebissonii f. biundulata (O. Müller) Cleve-Euler Pl. VII, Fig. 14, Slide #292-1.

Critical reference: Cleve-Euler 1955, p. 54, Fig. 1072o.

Rare in the plankton at marsh station X (10 June 1970).

Pinnularia brevicostata P. T. Cleve var. brevicostata Pl. VII, Fig. 23, Slide #80-6.

Critical reference: Hustedt 1930, p. 329, Text fig. 609.

Rare in surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969).

Pinnularia kneuckeri Hust. var. kneuckeri Pl. VII, Fig. 17, Slide #279-3.

Critical reference: Hustedt 1949b, p. 50, Pl. 2, Fig. 22-32.

Uncommon in three marsh samples. Epiphytic on grasses at station XII (13 May 1970), in surface sediment from 60 cm water at station XII

(13 May 1970), and in scrapings from a floating plank at station XIII (13 May 1970).

Pinnularia nodosa (Ehr.) Wm. Smith var. *nodosa* Pl. VII, Fig. 15 and 16, Slide #161-1 and #279-3 respectively.

Critical reference: Patrick and Reimer 1966, p. 601, Pl. 55, Fig. 20-21.

Epiphytic on grasses at station XII (13 May 1970) and in surface sediment from 60 cm water at station VI (4 August 1969); rare.

Pinnularia ruttneri Hust. var. *ruttneri* Pl. VII, Fig. 21, Slide #25-1.

Critical reference: Patrick and Reimer 1966, p. 638, Pl. 64, Fig. 3.

Rare in the surface sediment from a shallow pool somewhat protected from wave action by rocks at lake station 9 (23 July 1968).

Pinnularis substomatophora Hust. var. *substomatophora* Pl. VII, Fig. 22, Slide #279-1.

Critical reference: Patrick and Reimer 1966, p. 610, Pl. 57, Fig. 6.

Rare in two marsh samples. Epiphytic on grasses at station XII (13 May 1970) and in surface sediment from 60 cm water at station XIII (13 May 1970).

Pinnularia viridis (Nitzsch) Ehr. var. *viridis* Pl. VII, Fig. 10, Slide #22-5.

Critical reference: Patrick and Reimer 1966, p. 639, Pl. 64, Fig. 5.

Rare in one sample from each study area. Epiphytic on *Potamogeton pectinatus* at marsh station X (22 July 1970) and in scrapings from just below the splash zone of rocks at lake station 8 (23 July 1968).

Pinnularia viridis var. *intermedia* P. T. Cleve Pl. VII, Fig. 11, Slide #279-2.

Critical reference: Cleve-Euler 1955, p. 74, Fig. 1103c-d.

Rare in three marsh samples and in one lake sample. Epiphytic on grasses at marsh station XII (13 May 1970); in surface sediment from 30 cm water at marsh station VII (21 July 1969) and from 60 cm water at marsh station XIII (13 May 1970). In the lake plankton at station 8 (10 June 1970).

Pinnularia sp. #2 Pl. VII, Fig. 18, Slide #132-9.

Rare in the surface sediment in 30 cm water at marsh station VII (21 July 1969).

Rhizosolenia Brightwell nom. cons. non Ehr.

Rhizosolenia eriensis H. L. Smith var. *eriensis* Pl. XVIII, Fig. 9, Slide #173-1.

Critical reference: Hustedt 1930, p. 115, Text fig. 92.

Rare to uncommon in eight lake plankton samples from station 8; also found in a qualitative plankton sample from station 5 (10 August 1969), but no proportional count was made for this sample. This diatom was quite seasonal, occurring only from July to October with its highest frequency (1.7×10^4 cells/liter) on 29 September 1969.

Rhoicosphenia Grun.

Rhoicosphenia curvata (Kütz.) Grun. *ex* Rabh. var. *curvata* Pl. III, Fig. 15-17, Slide #124-1.

Critical reference: Patrick and Reimer 1966, p. 282, Pl. 20, Fig. 1-5.

Rare in five marsh samples and one lake sample. Epiphytic on a variety of plants, but also found in two plankton samples. Observed only in July and August.

Rhopalodia O. Müller

Rhopalodia gibba (Ehr.) O. Müller var. gibba Pl. III, Fig. 14, Slide #78-2.

Critical reference: Hustedt 1930, p. 390, Text fig. 740.

Rare in 13 lake samples and rare to common in 13 marsh samples. Appeared to develop best as an epiphyte on a variety of plants in both study areas. Common only as an epiphyte in squeezings of a mixed population of Lemna trisulca and L. minor at marsh station VI (4 August 1969), otherwise rare to uncommon. Seems to develop best from May to August.

Stauroneis Ehr.

Stauroneis acuta Wm. Smith var. acuta Pl. V, Fig. 3, Slide #80-8.

Critical reference: Patrick and Reimer 1966, p. 367, Pl. 31, Fig. 1.

Rare in surface sediments from 30 cm water at marsh station VII (21 July 1969) and from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969).

Stauroneis anceps Ehr. var. anceps Pl. V, Fig. 8, Slide #132-4.

Critical reference: Patrick and Reimer 1966, p. 361, Pl. 30, Fig. 1.

Rare in two marsh samples; in the plankton at station X (15 April 1970) and in surface sediment from 30 cm water at station VII (21 July 1969).

Stauroneis phoenicenteron (Nitzsch) Ehr. var. phoenicenteron Pl. V, Fig. 4, Slide #80-1.

Critical reference: Patrick and Reimer 1966, p. 359, Pl. 29, Fig. 1-2.

Rare in three lake samples. Epiphytic on Potamogeton pectinatus at station 2 (22 July 1968); in the surface sediments from 1.5 m water (including 61 cm ice covered with 13 cm snow) at station 12a (7 March 1969) and from 4.0 m water (including 61 cm ice covered with 15 cm snow) at station 14 (7 March 1969).

Stauroneis phoenicenteron f. gracilis (Ehr.) Hust. Pl. V, Fig. 5, Slide #130-2.

Critical reference: Patrick and Reimer 1966, p. 359, Pl. 29, Fig. 3-4.

Rare in a long surface plankton tow across the lake between stations 1 and 7 (23 June 1969).

Stauroneis phoenicenteron var. intermedia (Dippel) Cleve-Euler Pl. V, Fig. 6, Slide #84-1.

Critical reference: Cleve-Euler 1932, p. 117, Fig. 321a-b.

Rare in the surface sediment from 4.0 m water (including 61 cm ice covered with 15 cm snow) at lake station 14 (7 March 1969).

Stauroneis sp. #1 Pl. V, Fig. 7, Slide #280-2.

Rare in the surface sediment from 60 cm water at marsh station XII (13 May 1970).

Stephanodiscus Ehr.

Stephanodiscus astraea var. minutula (Kütz.) Grun. Pl. I, Fig. 2, Slide #70-1.

Critical reference: Hustedt 1930, p. 110, Text fig. 86.

In 31 marsh samples and 16 lake samples. In a variety of lake samples with no clear indication of habitat preference or periodicity. This taxon was a major contributor to the marsh plankton from 29 September to 10 November 1969, with a maximum standing crop (4.0×10^5 cells/liter) on 27 October.

Stephanodiscus invisitatus Hohn & Hellerman var. invisitatus Pl. I, Fig. 3, Slide #187-1.

Critical reference: Hohn and Hellerman 1963, p. 325, Pl. I, Fig. 7.

Rare to abundant in eight lake samples and rare in three marsh samples. Best development in the lake plankton where it reached its highest frequency (abundant) on 8 December 1969. No clear indication of habitat preference or seasonal periodicity in the marsh.

Stephanodiscus niagarae Ehr. var. niagarae Pl. I, Fig. 1, Slide #22-1.

Critical reference: Van Heurck 1880-1883, Pl. 95, Fig. 13-14.

Rare to uncommon in 39 lake samples and rare in five marsh samples. Best development as a plankter in both study areas; most frequently encountered from April to October in both study areas.

Surirella Turpin

Surirella angusta Kütz. var. angusta Pl. XVII, Fig. 7, Slide #86-1.

Critical reference: Hustedt 1930, p. 435, Text fig. 844-845.

Rare to uncommon in 20 marsh samples and rare in one lake sample. Encountered most frequently in the marsh plankton, but observed in a variety of other marsh habitats. In the lake plankton at station 8 (15 April 1970). No clear indication of periodicity.

Surirella biseriata f. punctata Meister Pl. XVII, Fig. 1-2, Slide #268-2 and #84-1 respectively.

Critical reference: Cleve-Euler 1952, p. 105, Text fig. 1528c.

Rare in two lake samples. In the surface sediment from 4.0 m water (including 61 cm ice covered with 15 cm snow) at station 14 (7 March 1969) and in scrapings of rocks from 18 cm water at station 8 (29 April 1970).

Surirella kittoni A. Schmidt var. kittoni Pl. XVII, Fig. 6, Slide #326-1.

Critical reference: Schmidt 1885 in Schmidt et al. 1874-1959, Pl. 23, Fig. 12-14.

Rare in scrapings of rocks from 2.1 m water at lake station 8 (22 July 1970).

Surirella linearis var. constricta (Ehr.) Grun. Pl. XVII, Fig. 4, Slide #80-5.

Critical reference: Hustedt 1930, p. 434, Text fig. 839.

Rare in the surface sediment from 1.5 m water (including 61 cm ice covered with 13 cm snow) at lake station 12a (7 March 1969).

Surirella linearis var. helvetica (Brun) Meister Pl. XVII, Fig. 5, Slide #25-2.

Critical reference: Hustedt 1930, p. 434, Text fig. 840.

Rare in the surface sediment from a shallow pool somewhat protected from wave action by rocks at lake station 9 (23 July 1968).

Surirella ovata Kütz. var. ovata Pl. XVII, Fig. 8, Slide #138-1.

Critical reference: Hustedt 1930, p. 442, Text fig. 863-864.

Rare in two marsh samples. In squeezings of algae and debris from bottom in 30 cm water at station IX (21 July 1969) and in surface sediment from 15 cm water at station IV (7 July 1969).

Surirella ovata var. pinnata (Wm. Smith) Hust. Pl. XVII, Fig. 9, Slide #261-1.

Critical reference: Hustedt 1930, p. 442, Text fig. 865.

Rare in five marsh samples. In one surface sediment sample, two epiphytic samples, and two plankton samples. No clear indication of periodicity.

Surirella robusta Ehr. var. robusta Pl. XVI, Fig. 12, Slide #130-1.

Critical reference: Boyer 1916, p. 124, Pl. 36, Fig. 2.

Rare in a long surface plankton tow across the lake between stations 1 and 7 (23 June 1969).

Surirella tenera var. nervosa A. Schmidt Pl. XVII, Fig. 3, Slide #268-2.

Critical reference: Hustedt 1930, p. 439, Text fig. 854-855.

Rare in scrapings of rocks from 18 cm water at lake station 8 (29 April 1970).

Synedra Ehr.

Synedra acus Kütz. var. acus Pl. II, Fig. 21, Slide #158-2.

Critical reference: Patrick and Reimer 1966, p. 135, Pl. 5, Fig. 1.

Rare to abundant in 43 lake samples and 27 marsh samples. No clear indication of habitat preference or seasonal periodicity.

Synedra parasitica (Wm. Smith) Hust. var. parasitica Pl. II, Fig. 17, Slide #22-5.

Critical reference: Patrick and Reimer 1966, p. 140, Pl. 5, Fig. 12.

Rare in three lake samples. In the surface sediments from 1.5 m water (including 61 cm ice covered with 13 cm snow) at station 12a

(7 March 1969) and from 3.0 m water at station 8 (22 July 1970); in scrapings from just below the splash zone of rocks at station 8 (23 July 1968).

Synedra rumpens var. familiaris (Kütz.) Hust. Pl. II, Fig. 23, Slide #162-1.

Critical reference: Patrick and Reimer 1966, p. 143, Pl. 5, Fig. 19.

Rare in squeezings of a mixed population of Lemna trisulca and L. minor from marsh station VI (4 August 1969).

Synedra rumpens var. fragilarioides Grun. Pl. II, Fig. 22, Slide #7-1.

Critical reference: Patrick and Reimer 1966, p. 144, Pl. 6, Fig. 1.

Rare to uncommon in four lake samples and rare in three marsh samples. Most frequently encountered in the lake as a plankter (November, December, January and April). An epiphyte on Najas sp. at marsh station I (23 July 1968) and on Nymphaea tuberosa at marsh station X (22 July 1970); also found in a composite sample from the marsh.

Synedra ulna (Nitzsch) Ehr. var. ulna Pl. II, Fig. 18-19, Slide #138-1 and #138-2 respectively.

Critical reference: Patrick and Reimer 1966, p. 148, Pl. 7, Fig. 2.

Rare to uncommon in 18 marsh samples and rare in one lake sample. Most frequently encountered as an epiphyte on a variety of plants in the marsh, but also frequently encountered in the surface sediments there; best development in July. Observed only in a composite sample from the lake.

Synedra ulna var. oxyrhynchus (Kütz.) Van Heurck Pl. II, Fig. 20, Slide #332-1.

Critical reference: Hustedt 1932, p. 198, Text fig. 691b.

Rare in three lake samples and one marsh sample. In squeezings of a mixed population of filamentous green algae from lake station 8a (4 August 1969), in scrapings of rocks from 30 cm water at lake station 8a (29 April 1970), and in a composite sample from the lake. Epiphytic on dead and decaying *Typha latifolia* and *Scirpus* sp. from marsh station XIV (13 May 1970) and in a composite sample from the marsh.

Synedra sp. #1 Pl. III, Fig. 1, Slide #332-1.

Rare in a composite sample from the marsh.

This taxon appears to be what Stoermer (1964) reported from Clear Lake as *S. goulardi* Bréb. var. *goulardi*. However, my specimens and the specimen illustrated by Stoermer do not fit the description of *S. goulardi* var. *goulardi*. *Synedra* sp. #1 more closely resembles *Synedra pseudogoulardii* Manguin and perhaps should be considered a variety thereof.

Tabellaria Ehr.

Tabellaria sp. #1 Pl. I, Fig. 15, Slide #302-1.

A few valves of this taxon were found in scrapings of rocks from 30-40 cm water from lake station 8 (24 June 1970). An exhaustive examination of both cleaned and uncleaned portions of this material failed to produce a single complete frustule of this taxon and, as a result, I have been unable to identify this diatom beyond the generic level (entire frustules are required for this purpose). It seems very probable that this diatom is not part of the present flora of Clear Lake and that the valves I have seen are of fossil origin.

Plate I

Fig. 1. *Stephanodiscus niagarae* var. *niagarae* X1000 p. 117.
Fig. 2. *Stephanodiscus astraea* var. *minutula* X2000 p. 116.
Fig. 3. *Stephanodiscus invisitatus* var. *invisitatus* X2000 p. 117.
Fig. 4. *Cyclotella comta* var. *comta* X2000 p. 49.
Fig. 5. *Cyclotella bodanica* var. *bodanica* X1000 p. 49.
Fig. 6. *Cyclotella meneghiniana* var. *meneghiniana* X2000 p. 50.
Fig. 7- 8. *Cyclotella stelligera* var. *stelligera* X2000 p. 50.
Fig. 9-10. *Melosira granulata* var. *granulata* X1000 p. 77.
Fig. 11. *Melosira granulata* var. *angustissima* X1000 p. 77.
Fig. 12. *Melosira varians* var. *varians* X1000 p. 78.
Fig. 13. *Melosira italica* var. *italica* X1000 p. 77.
Fig. 14. *Melosira ambigua* var. *ambigua* X1000 p. 76.
Fig. 15. *Tabellaria* sp. X1000 p. 121.
Fig. 16. *Diatoma vulgare* var. *vulgare* X1000 p. 58.
Fig. 17. *Meridion circulare* var. *circulare* X1000 p. 78.

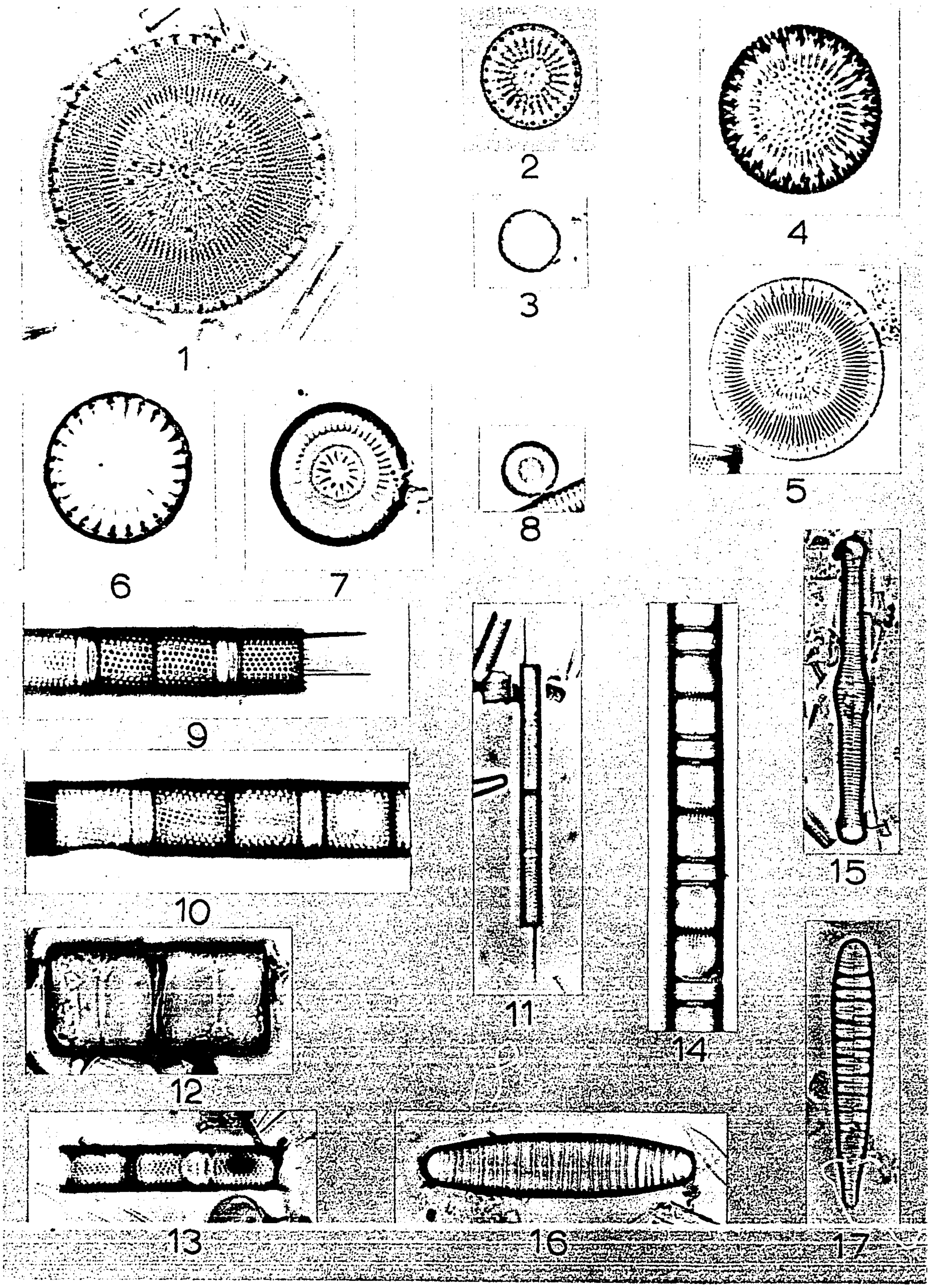

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Plate II

Fig. 1. <u>Opephora</u> <u>martyi</u> var. <u>martyi</u> X2000 p. 111.
Fig. 2. <u>Fragilaria</u> <u>brevistriata</u> var. <u>brevistriata</u> X1000 p. 61.
Fig. 3. <u>Fragilaria</u> <u>brevistriata</u> var. <u>inflata</u> X2000 p. 61.
Fig. 4. <u>Fragilaria</u> <u>brevistriata</u> var. <u>subcapitata</u> X1000 p. 61.
Fig. 5- 6. <u>Fragilaria</u> <u>pinnata</u> var. <u>lancettula</u> X2000 p. 64.
Fig. 7. <u>Fragilaria</u> <u>virescens</u> var. <u>virescens</u> X1000 p. 65.
Fig. 8. <u>Fragilaria</u> <u>crotonensis</u> var. <u>prolongata</u> X1000 p. 63.
Fig. 9. <u>Fragilaria</u> <u>crotonensis</u> var. <u>crotonensis</u> X1000 p. 63.
Fig. 10-11. <u>Fragilaria</u> <u>vaucheriae</u> var. <u>vaucheriae</u> X1000 p. 65.
Fig. 12. <u>Fragilaria</u> <u>vaucheriae</u> var. <u>capitellata</u> X1000 p. 65.
Fig. 13. <u>Fragilaria</u> <u>construens</u> var. <u>construens</u> X2000 p. 62.
Fig. 14. <u>Fragilaria</u> <u>construens</u> var. <u>venter</u> X2000 p. 63.
Fig. 15. <u>Fragilaria</u> <u>capucina</u> var. <u>capucina</u> X1000 p. 62.
Fig. 16. <u>Fragilaria</u> <u>capucina</u> var. <u>mesolepta</u> X1000 p. 62.
Fig. 17. <u>Synedra</u> <u>parasitica</u> var. <u>parasitica</u> X2000 p. 119.
Fig. 18-19. <u>Synedra</u> <u>ulna</u> var. <u>ulna</u> X1000 p. 120.
Fig. 20. <u>Synedra</u> <u>ulna</u> var. <u>oxyrhynchus</u> X1000 p. 120.
Fig. 21. <u>Synedra</u> <u>acus</u> var. <u>acus</u> X1000 p. 119.
Fig. 22. <u>Synedra</u> <u>rumpens</u> var. <u>fragilarioides</u> X1000 p. 120.
Fig. 23. <u>Synedra</u> <u>rumpens</u> var. <u>familiaris</u> X1000 p. 120.

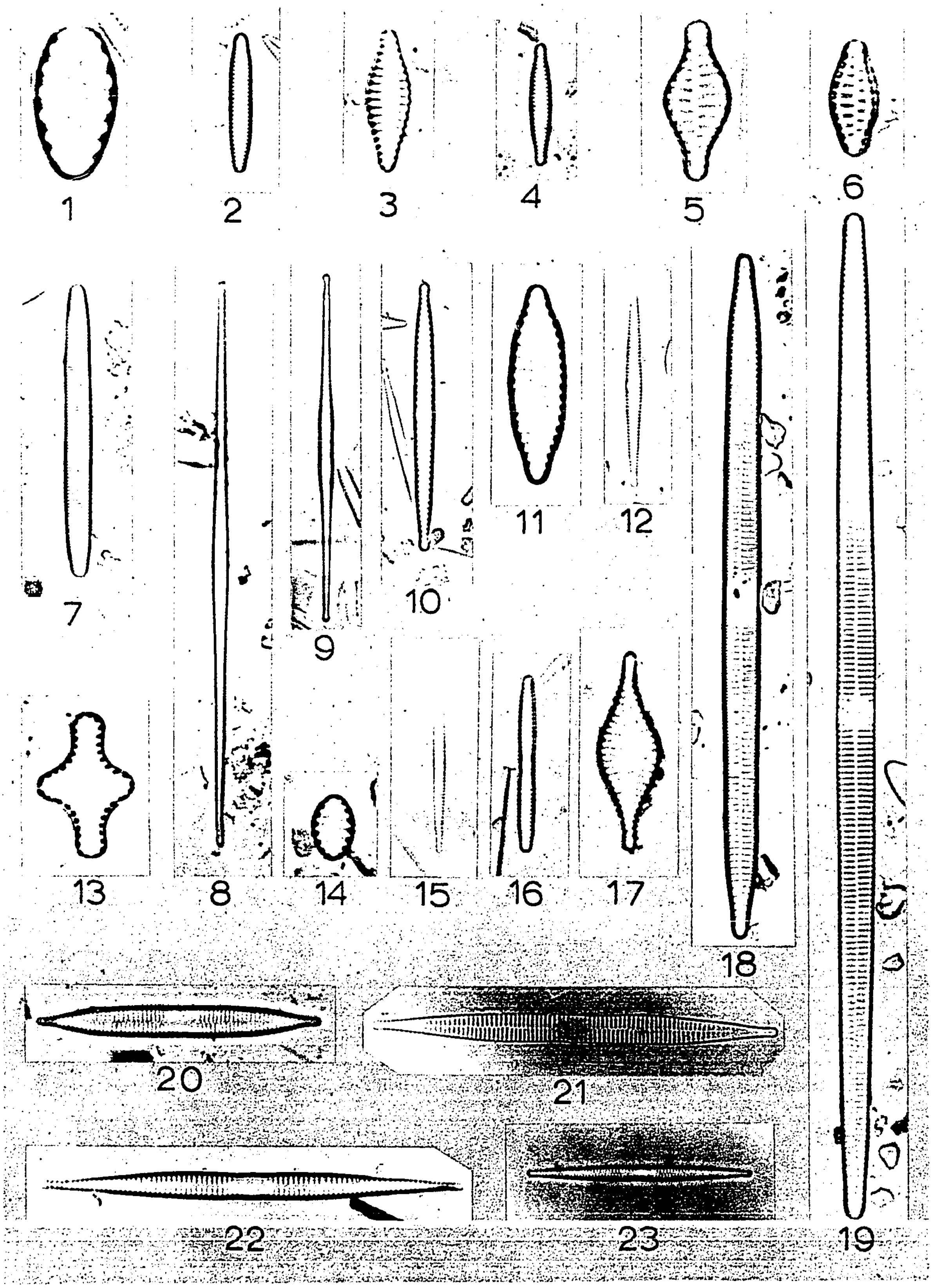
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Plate III

Fig. 1. *Synedra* sp. #1 X1000 p. 121.
Fig. 2. *Asterionella formosa* var. *formosa* X1000 p. 44.
Fig. 3- 4. *Eunotia formica* var. *formica* X1000 p. 60.
Fig. 5. *Eunotia curvata* var. *curvata* X1000 p. 60.
Fig. 6. *Eunotia pectinalis* var. *minor* X1000 p. 61.
Fig. 7- 8. *Cocconeis placentula* var. *placentula* X1000 p. 48.
Fig. 9. *Cocconeis placentula* var. *lineata* X1000 p. 48.
Fig. 10. *Cocconeis* sp. #1 X2000 p. 49.
Fig. 11. *Cocconeis* sp. #2 X2000 p. 49.
Fig. 12-13. *Cocconeis pediculus* var. *pediculus* X1000 p. 48.
Fig. 14. *Rhopalodia gibba* var. *gibba* X1000 p. 115.
Fig. 15-17. *Rhoicosphenia curvata* var. *curvata* X1000 p. 114.
Fig. 18. *Tropidoneis lepidoptera* var. *proboscidia* X1000 p. 158.
Fig. 19. *Mastogloia grevillei* var. *grevillei* X1000 p. 76.

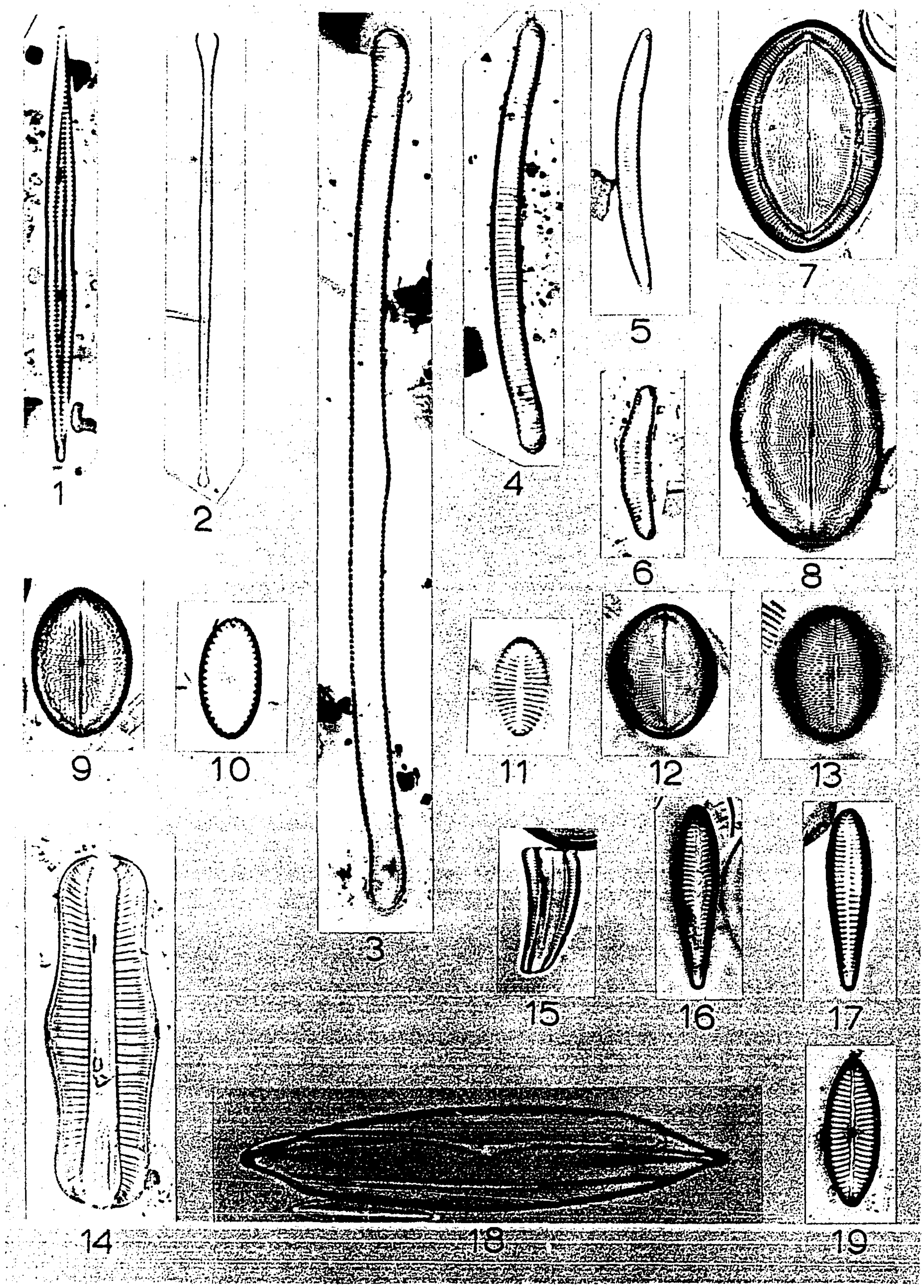
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Plate IV

Fig. 1. *Achnanthes* *affinis* var. *affinis* X2000 p. 38.
Fig. 2- 3. *Achnanthes* *minutissima* var. *minutissima* X2000 p. 41.
Fig. 4- 5. *Achnanthes* *lanceolata* var. *lanceolata* X1000 p. 40.
Fig. 6- 7. *Achnanthes* *lancolata* var. *dubia* X2000 p. 40.
Fig. 8- 9. *Achnanthes* *exigua* var. *exigua* X2000 p. 39.
Fig. 10-11. *Achnanthes* *exigua* var. *heterovalva* X2000 p. 39.
Fig. 12-13. *Achnanthes* *lanceolata* var. *omissa* X2000 p. 41.
Fig. 14-15. *Achnanthes* *hungarica* var. *hungarica* X2000 p.339.
Fig. 16-17. *Achnanthes* *lapponica* var. *ninckei* X2000 p. 41.
Fig. 18-19. *Achnanthes* *clevei* var. *clevei* X2000 p. 39.
Fig. 20-21. *Achnanthes* *clevei* var. *rostrata* X2000 p. 39.
Fig. 22. *Amphipleura* *pellucida* var. *pellucida* X1000 p. 42.
Fig. 23. *Amphiprora* *ornata* var. *ornata* X1000 p. 42.

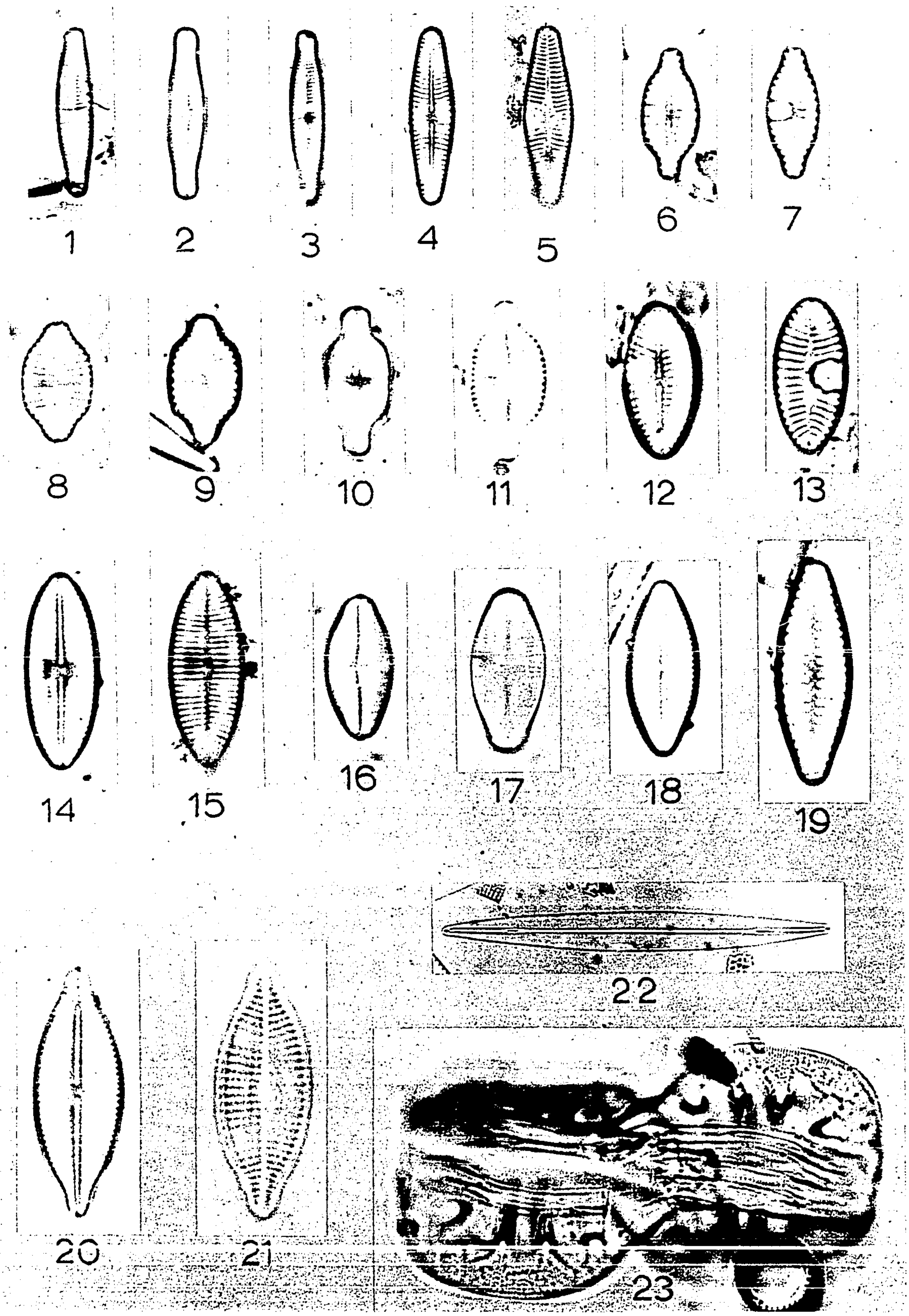
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Plate V

Fig. 1. *Gyrosigma spencerii* var. *spencerii* X1000 p. 75.
Fig. 2. *Gyrosigma attenuatum* var. *attenuatum* X500 p. 75.
Fig. 3. *Stauroneis acuta* var. *acuta* X1000 p. 115.
Fig. 4. *Stauroneis phoenicenteron* var. *phoenicentron* X500 p. 115.
Fig. 5. *Stauroneis phoenicenteron* f. *gracilis* X1000 p. 116.
Fig. 6. *Stauroneis phoenicenteron* var. *intermedia* X1000 p. 116.
Fig. 7. *Stauroneis* sp. #1 X2000 p. 116.
Fig. 8. *Stauroneis anceps* var. *anceps* X1000 p. 115.
Fig. 9. *Anomoeoneis vitrea* var. *vitrea* X2000 p. 44.
Fig. 10. *Anomoeoneis sphaerophora* var. *sphaerophora* X1000 p. 43.
Fig. 11. *Anomoeoneis sphaerophora* var. *sculpta* X1000 p. 44.

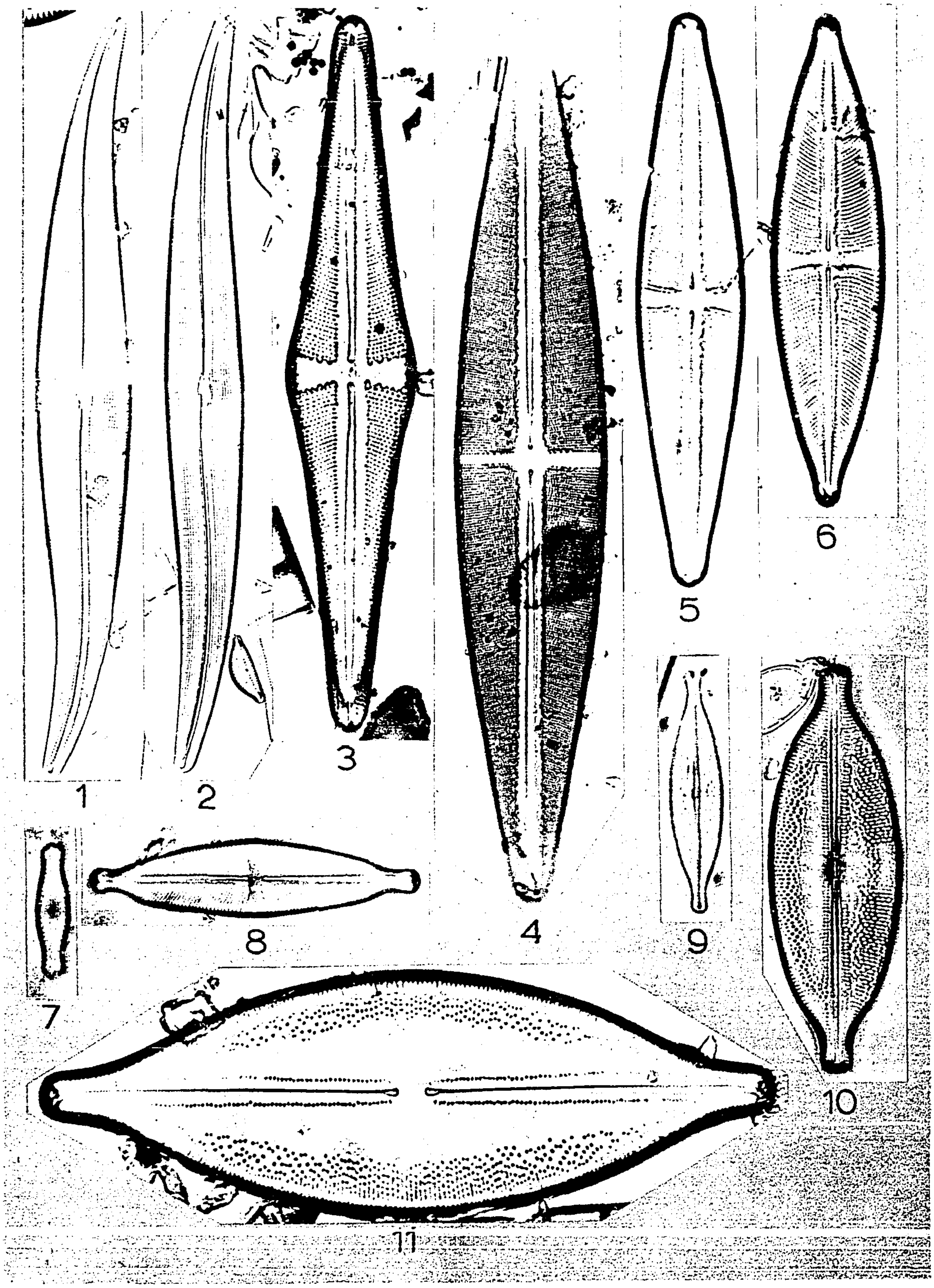
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Plate VI

Fig. 1- 2. *Neidium affine* var. *capitatum* X1000 p. 98.
Fig. 3. *Neidium affine* var. *tenuirostris* X1000 p. 98.
Fig. 4. *Neidium affine* var. *undulatum* X1000 p. 98.
Fig. 5- 6. *Neidium distincte-punctatum* var. *distincte-punctatum* X1000 p. 99.
Fig. 7. *Neidium decens* var. *decens* X1000 p. 99.
Fig. 8. *Neidium dubium* var. *dubium* X1000 p. 99.
Fig. 9. *Neidium hankensis* var. *hankensis* X1000 p. 99.
Fig. 10-11. *Neidium hankensis* var. *elongata* X1000 p. 100.
Fig. 12. *Neidium hitchcockii* var. *hitchcockii* X1000 p. 100.
Fig. 13-19. *Neidium iridis* var. *iridis* X1000 p. 100.
Fig. 14. *Neidium bisulcatum* var. *baicalense* X1000 p. 99.
Fig. 15. *Neidium iridis* var. *amphigomphus* X1000 p. 100.
Fig. 16. *Neidium iridis* var. *amphigomphus* f. *rostrata* X1000 p. 101.
Fig. 17. *Neidium* sp. #2 X1000 p. 101.
Fig. 18. *Neidium temperei* var. *temperei* X1000 p. 101.
Fig. 20. *Diploneis oculata* var. *oculata* X2000 p. 58.
Fig. 21. *Diploneis ovalis* var. *ovalis* X1000 p. 58.

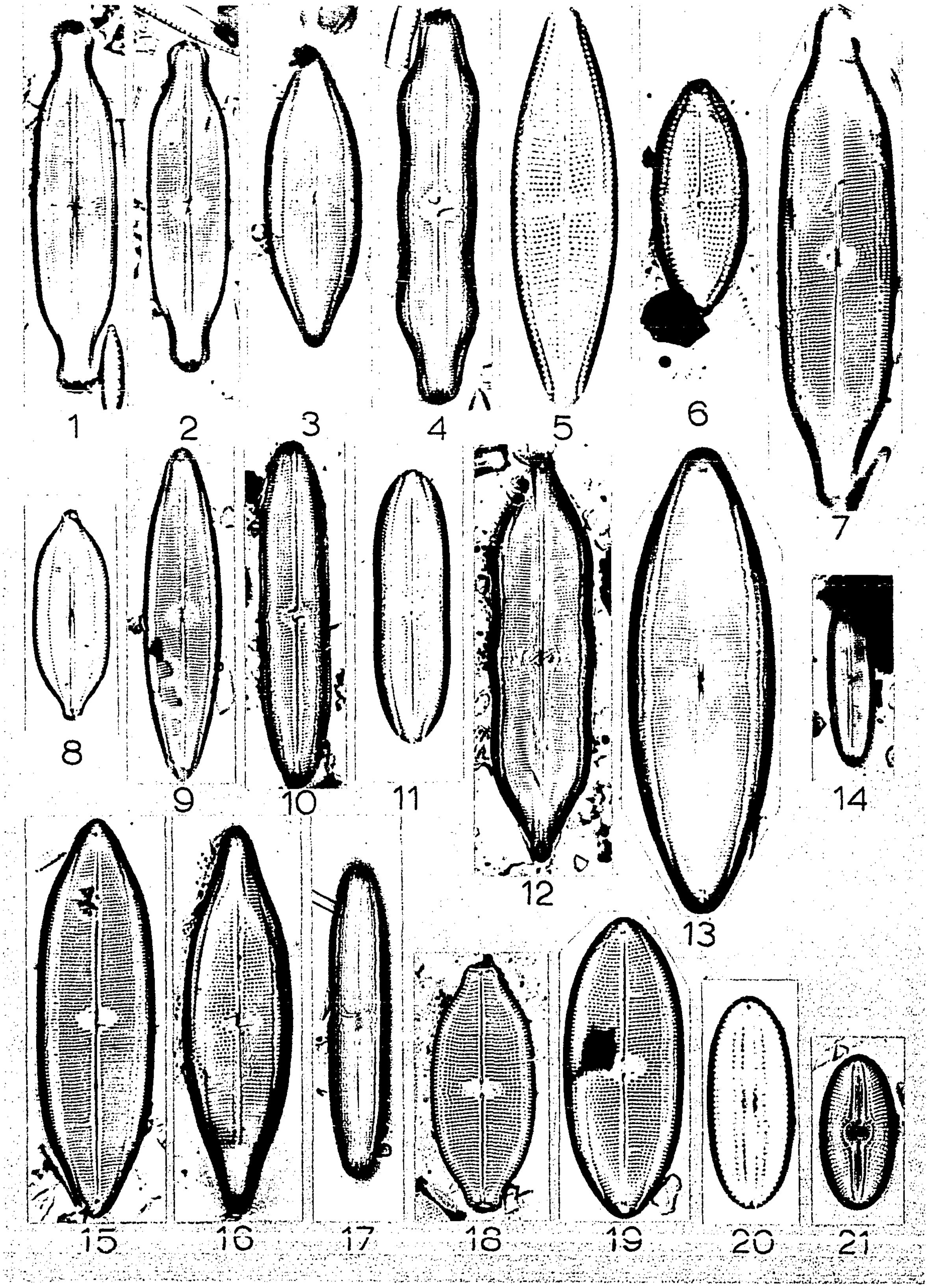
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Plate VII

Fig. 1. Caloneis bacillaris var. thermalis X1000 p. 45.
Fig. 2. Caloneis bacillaris var. thermalis f. ? X1000 p. 45.
Fig. 3. Caloneis bacillum var. bacillum X2000 p. 46.
Fig. 4. Caloneis clevei var. uruguayensis X1000 p. 46.
Fig. 5. Caloneis lewisii var. lewisii X1000 p. 47.
Fig. 6. Caloneis lewisii var. inflata X1000 p. 47.
Fig. 7. Caloneis schumanniana var. schumanniana X1000 p. 47.
Fig. 8. Caloneis silicula var. silicula X1000 p. 47.
Fig. 9. Caloneis silicula var. truncatula X1000 p. 47.
Fig. 10. Pinnularia viridis var. viridis X1000 p. 113.
Fig. 11. Pinnularia viridis var. intermedia X1000 p. 113.
Fig. 12. Pinnularia borealis var. borealis X1000 p. 112.
Fig. 13. Pinnularia brebissonii var. brebissonii X1000 p. 112.
Fig. 14. Pinnularia brebissonii f. biundulata X1000 p. 112.
Fig. 15-16. Pinnularia nodosa var. nodosa X1000 p. 113.
Fig. 17. Pinnularia kneuckeri var. kneuckeri X1000 p. 112.
Fig. 18. Pinnularia sp. #2 X1000 p. 114.
Fig. 19. Pinnularia acrosphaeria var. acrosphaeria X1000 p. 111.
Fig. 20. Pinnularia biceps var. biceps X1000 p. 111.
Fig. 21. Pinnularia ruttneri var. ruttneri X500 p. 113.
Fig. 22. Pinnularia substomatophora var. substomatophora X1000 p. 113.
Fig. 23. Pinnularia brevicostata var. brevicostata X1000 p. 112.

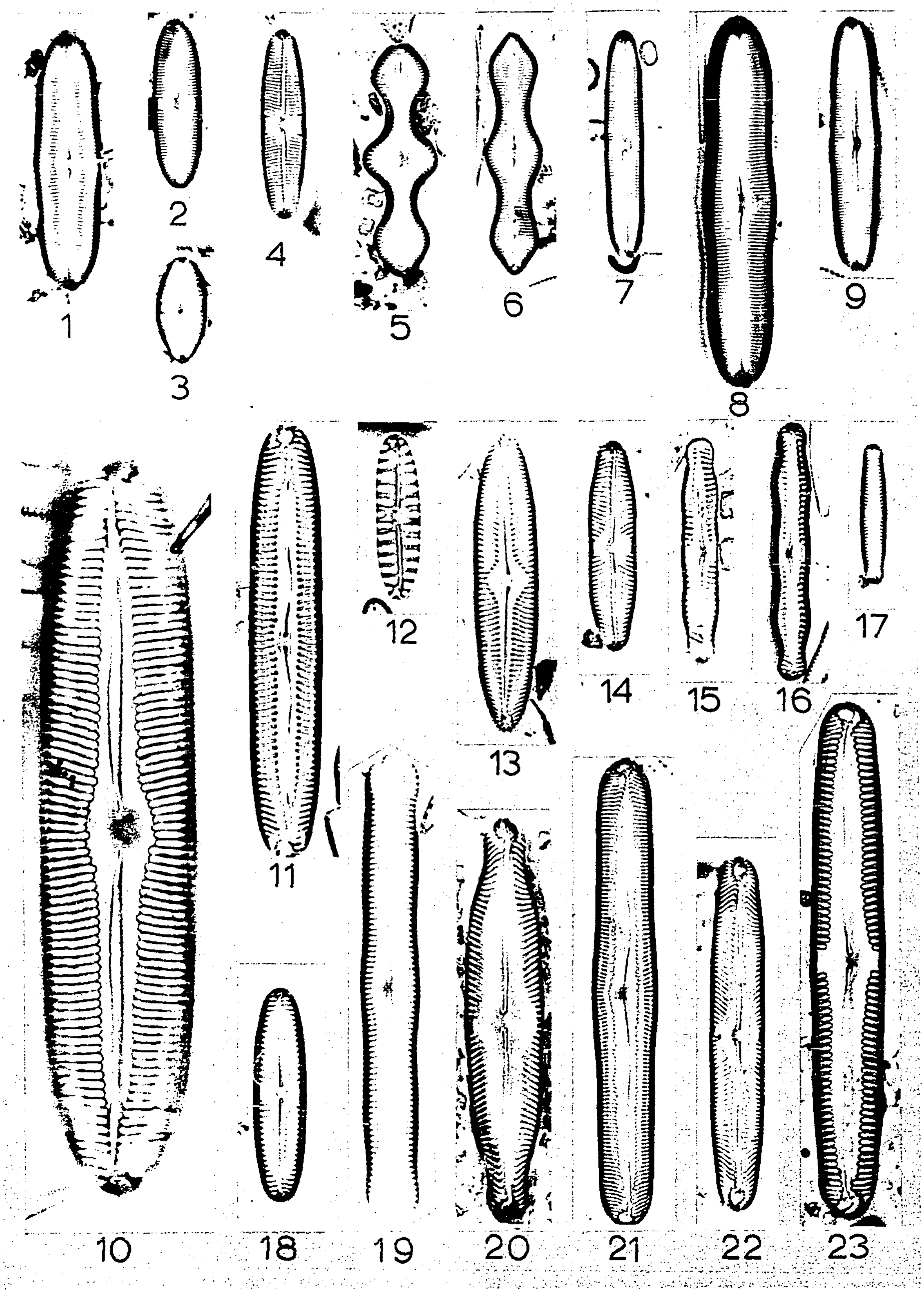
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Plate VIII

Fig. 1. *Amphora veneta* var. *veneta* X2000 p. 43.
Fig. 2- 3. *Amphora ovalis* var. *pediculus* X2000 and X1000 respectively p. 43.
Fig. 4. *Amphora ovalis* var. *libyca* X1000 p. 42.
Fig. 5- 7. *Cymbella turgida* var. *pseudogracilis* X1000 p. 56.
Fig. 8. *Cymbella* sp. #6 (post-auxospore) X1000 p. 57.
Fig. 9-13. *Cymbella caespitosum* var. *caespitosum* X1000 p. 52.
Fig. 14. *Cymbella sinuata* var. *sinuata* X2000 p. 56.
Fig. 15. *Cymbella schweickerdtii* var. *schweickerdtii* X1000 (see also Pl. IX, Fig. 12) p. 56.
Fig. 16. *Cymbella affinis* var. *affinis* X1000 p. 51.
Fig. 17. *Cymbella ruttneri* var. *obtusa* X2000 p. 55.
Fig. 18. *Cymbella cuspidata* var. *cuspidata* X1000 p. 53.
Fig. 19-22. *Cymbella* sp. #6 X1000 p. 57.
Fig. 23. *Cymbella hustedtii* var. *hustedtii* X2000 p. 54.
Fig. 24. *Cymbella microcephala* var. *microcephala* X2000 p. 54.

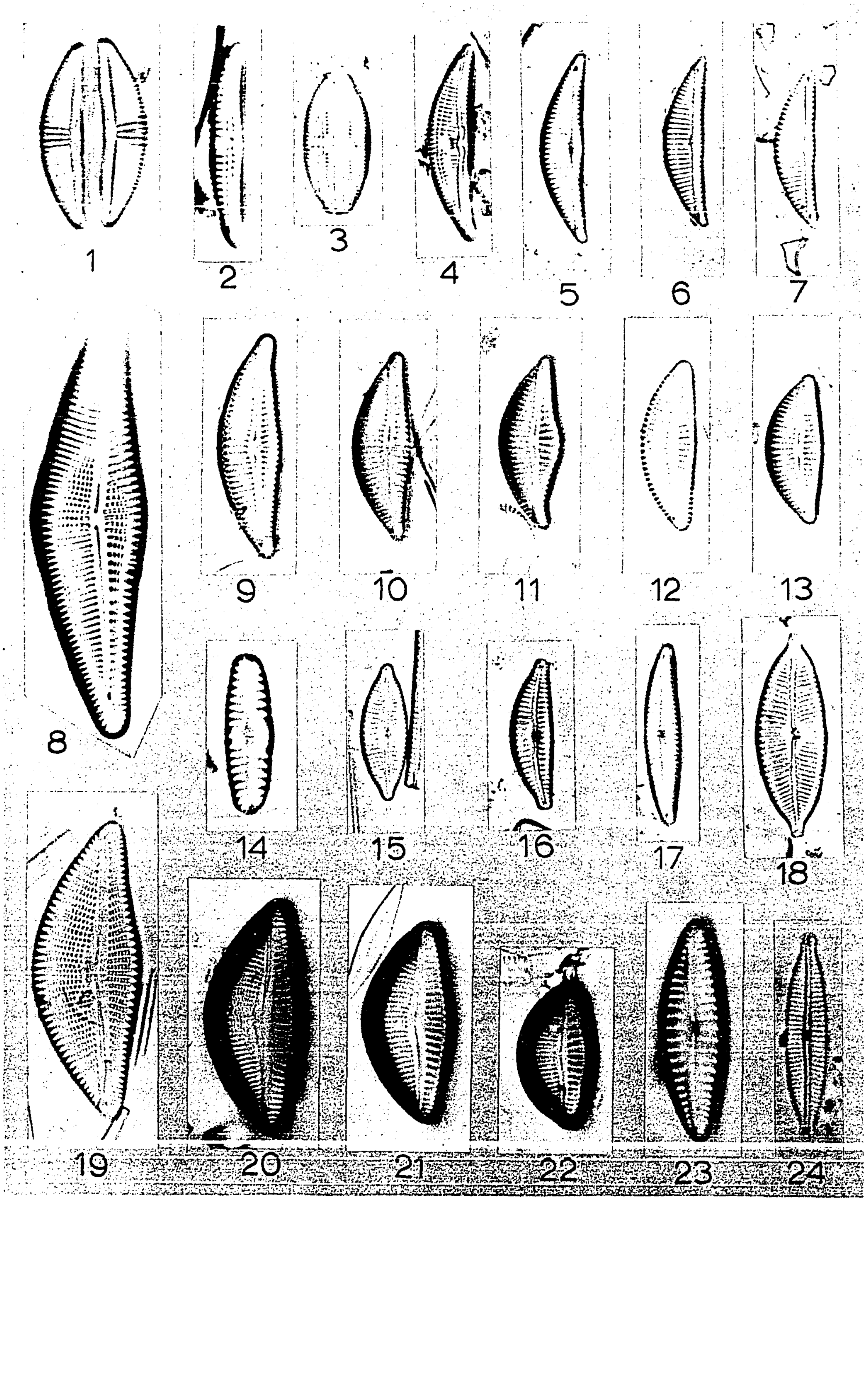
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Plate IX

Fig. 1. _Cymbella_ sp. #7 p. 57.
Fig. 2. _Cymbella_ sp. #8 p. 57.
Fig. 3- 4. _Cymbella cistula_ var. _cistula_ X1000 p. 52.
Fig. 5. _Cymbella aspera_ var. _aspera_ X1000 p. 52.
Fig. 6. _Cymbella inaequalis_ var. _inaequalis_ X1000 p. 53.
Fig. 7- 8. _Cymbella prostrata_ var. _prostrata_ X1000 p. 55.
Fig. 9. _Cymbella triangulum_ var. _triangulum_ X1000 p. 56.
Fig. 10. _Cymbella obtusiuscula_ var. _obtusiuscula_ X2000 p. 55.
Fig. 11. _Cymbella hybrida_ var. _hybrida_ X1000 p. 54.
Fig. 12. _Cymbella schweickerdtii_ var. _schweickerdtii_ X1000 (see also Pl. VIII, Fig. 15) p. 56.
Fig. 13. _Cymbella ventricosa_ var. _splendens_ X1000 p. 56.

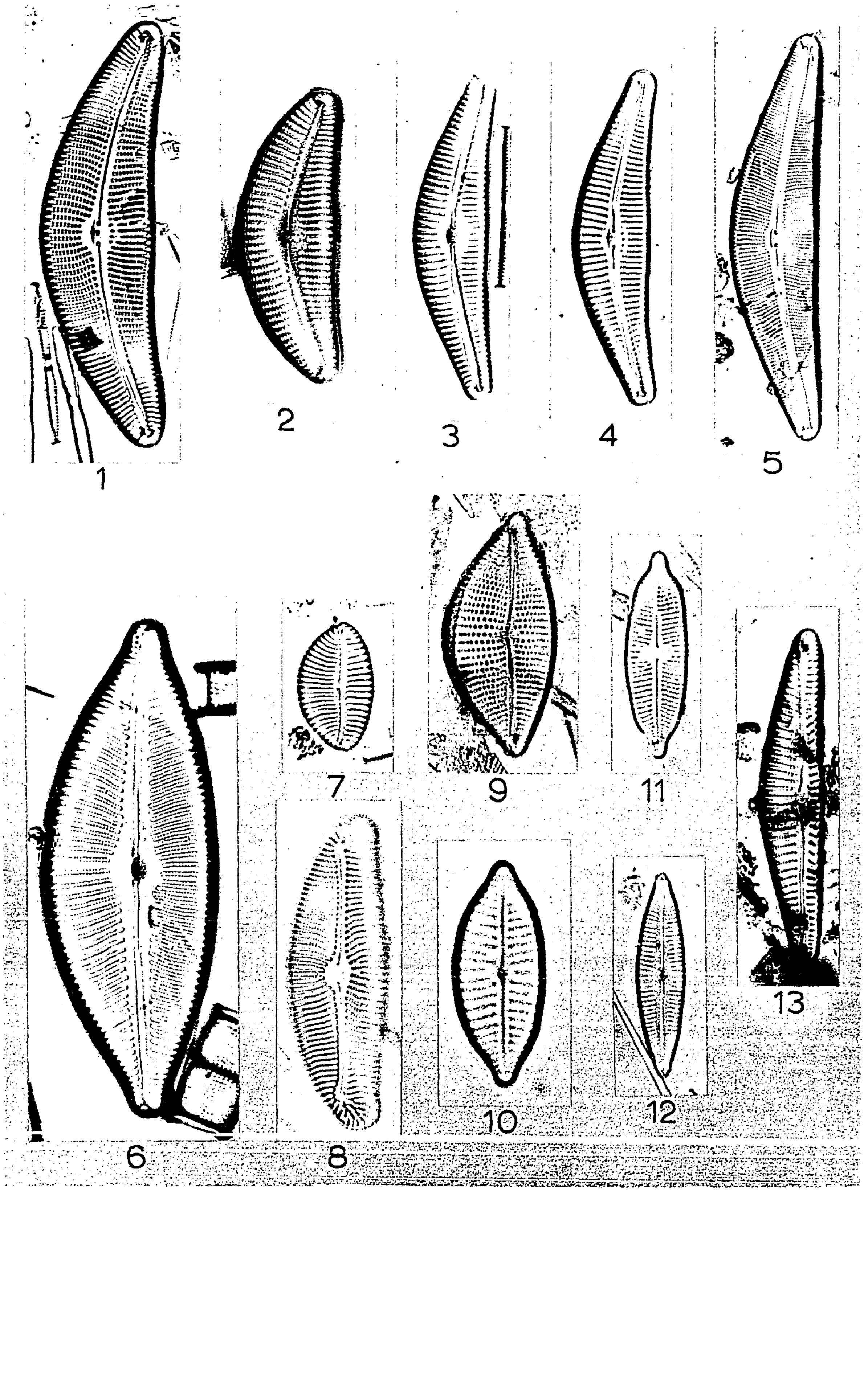
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Plate X

Fig.	1- 3.	*Navicula viridula* var. *argunensis* X1000 p. 97.
Fig.	4.	*Navicula heufleri* var. *heufleri* X1000 p. 85.
Fig.	5.	*Navicula cincta* var. *rostrata* X1000 p. 81.
Fig.	6.	*Navicula lanceolata* var. *lanceolata* X1000 p. 86.
Fig.	7.	*Navicula salinarum* var. *intermedia* X1000 p. 93.
Fig.	8.	*Navicula cryptocephala* var. *cryptocephala* X1000 p. 82.
Fig.	9.	*Navicula cryptocephala* var. *veneta* X1000 p. 83.
Fig.	10.	*Navicula cryptocephala* f. *minuta* X2000 p. 82.
Fig.	11.	*Navicula menisculus* var. *obtusa* X2000 p. 86.
Fig.	12.	*Navicula menisculus* var. *upsaliensis* X1000 p. 87.
Fig.	13.	*Navicula minima* var. *minima* X2000 p. 87.
Fig.	14.	*Navicula radiosa* var. *radiosa* X1000 p. 92.
Fig.	15-17.	*Navicula radiosa* var. *tenella* X1000 p. 93.
Fig.	18.	*Navicula radiosa* var. *parva* X1000 p. 92.
Fig.	19.	*Navicula vulpina* var. *vulpina* X1000 p. 97.
Fig.	20.	*Navicula aurora* var. *aurora* X1000 p. 80.
Fig.	21.	*Navicula tripunctata* var. *tripunctata* X1000 p. 96.
Fig.	22.	*Navicula graciloides* var. *graciloides* X1000 p. 85.
Fig.	23.	*Navicula contenta* f. *parallela* X2000 p. 82.
Fig.	24.	*Navicula reinhardtii* var. *reinhardtii* X1000 p. 93.
Fig.	25.	*Navicula tantula* var. *tantula* X2000 p. 95.
Fig.	26-27.	*Navicula mutica* var. *mutica* X2000 p. 88.
Fig.	28.	*Navicula mutica* var. ? X2000 p. 88.
Fig.	29.	*Navicula mutica* var. *undulata* X2000 p. 88.
Fig.	30.	*Navicula oblonga* var. *oblonga* X1000 p. 90.
Fig.	31.	*Navicula amphibola* var. *amphibola* X1000 p. 79.

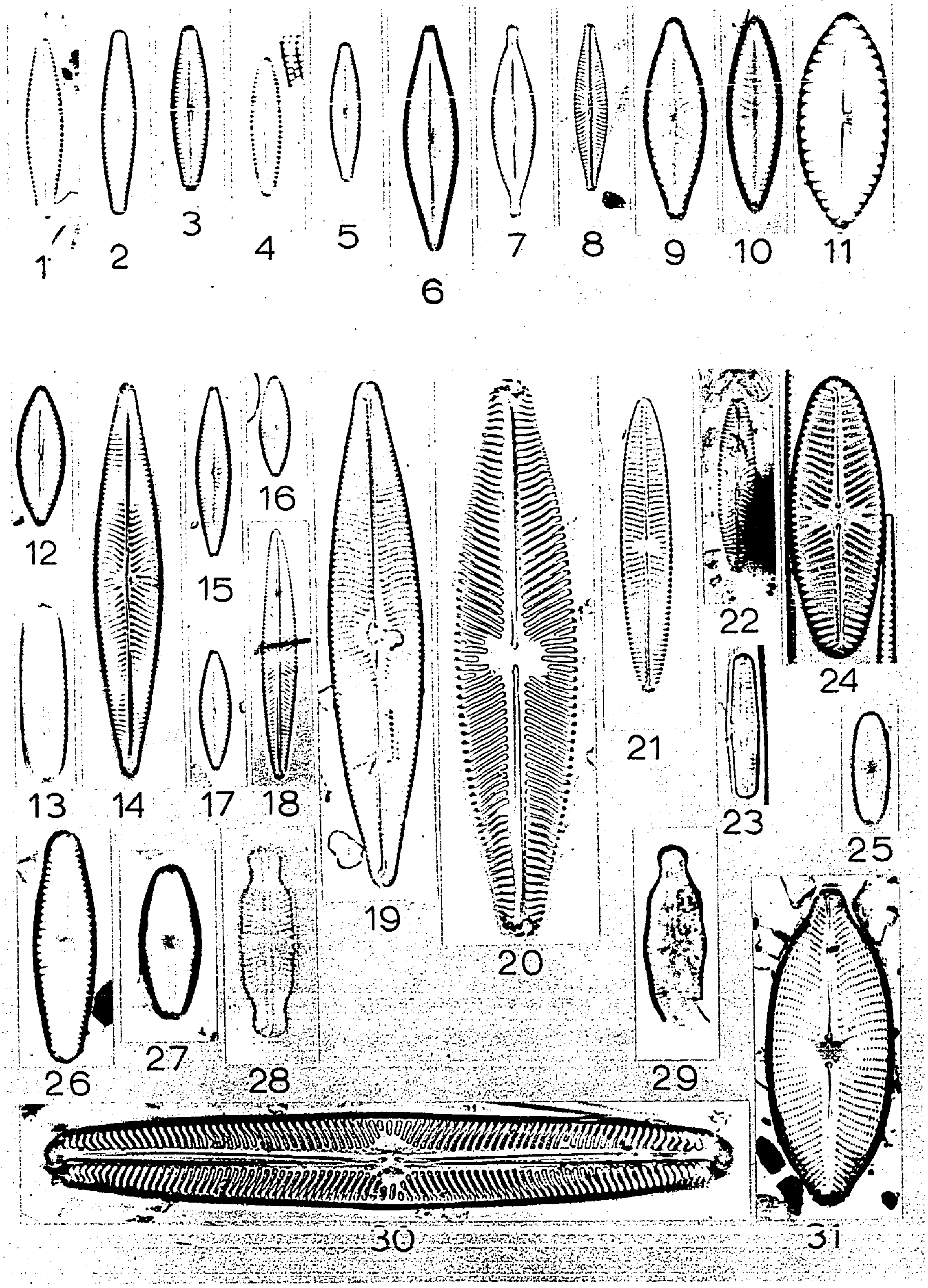
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Plate XI

Fig. 1- 1a. Navicula cuspidata var. major X500 and X1000 respectively p. 83.
Fig. 2. Navicula vanheurckii var. vanheurckii X2000 p. 97.
Fig. 3. Navicula luzonensis var. luzonensis X2000 p. 86.
Fig. 4. Navicula subrotundata var. subrotundata X2000 p. 95.
Fig. 5. Navicula cuspidata var. cuspidata X1000 p. 83.
Fig. 6. Navicula cuspidata var. heribaudii X1000 p. 83.
Fig. 7. Navicula pupula var. pupula X1000 p. 91.
Fig. 8. Navicula pupula var. rectangularis X1000 p. 92.
Fig. 9. Navicula pupula var. ? X2000 p. 92.
Fig. 10. Navicula nyassensis f. minor X1000 p. 89.
Fig. 11. Navicula platycephala var. platycephala X1000 p. 91.
Fig. 12. Navicula wittrockii var. wittrockii X1000 p. 97.
Fig. 13. Navicula sp. #16 X2000 p. 98.
Fig. 14-15. Navicula simplex var. simplex X1000 p. 95.
Fig. 16. Navicula seminulum var. seminulum X2000 p. 94.
Fig. 17. Navicula nigrii var. nigrii X2000 (see also Pl. XVIII, Fig. 1-2) p. 88.
Fig. 18. Navicula dicephala var. dicephala X1000 p. 84.
Fig. 19-20. Navicula dicephala var. rostrata X1000 p. 84.
Fig. 21. Navicula bryophila var. bryophila X2000 (see also Pl. XVIII, Fig. 4) p. 80.
Fig. 22. Navicula paludosa var. paludosa X2000 p. 90.
Fig. 23. Navicula abiskoensis var. abiskoensis X1000 p. 79.
Fig. 24. Navicula abiskoensis f. ? X1000 p. 79.
Fig. 25. Navicula biconica var. biconica X2000 p. 80.
Fig. 26. Navicula confervacea var. confervacea X2000 p. 82.
Fig. 27. Navicula accomodata var. accomodata X1000 p. 79.
Fig. 28-30. Navicula schoenfeldi var. schoenfeldi X1000, X1000, and X2000 respectively p. 94.

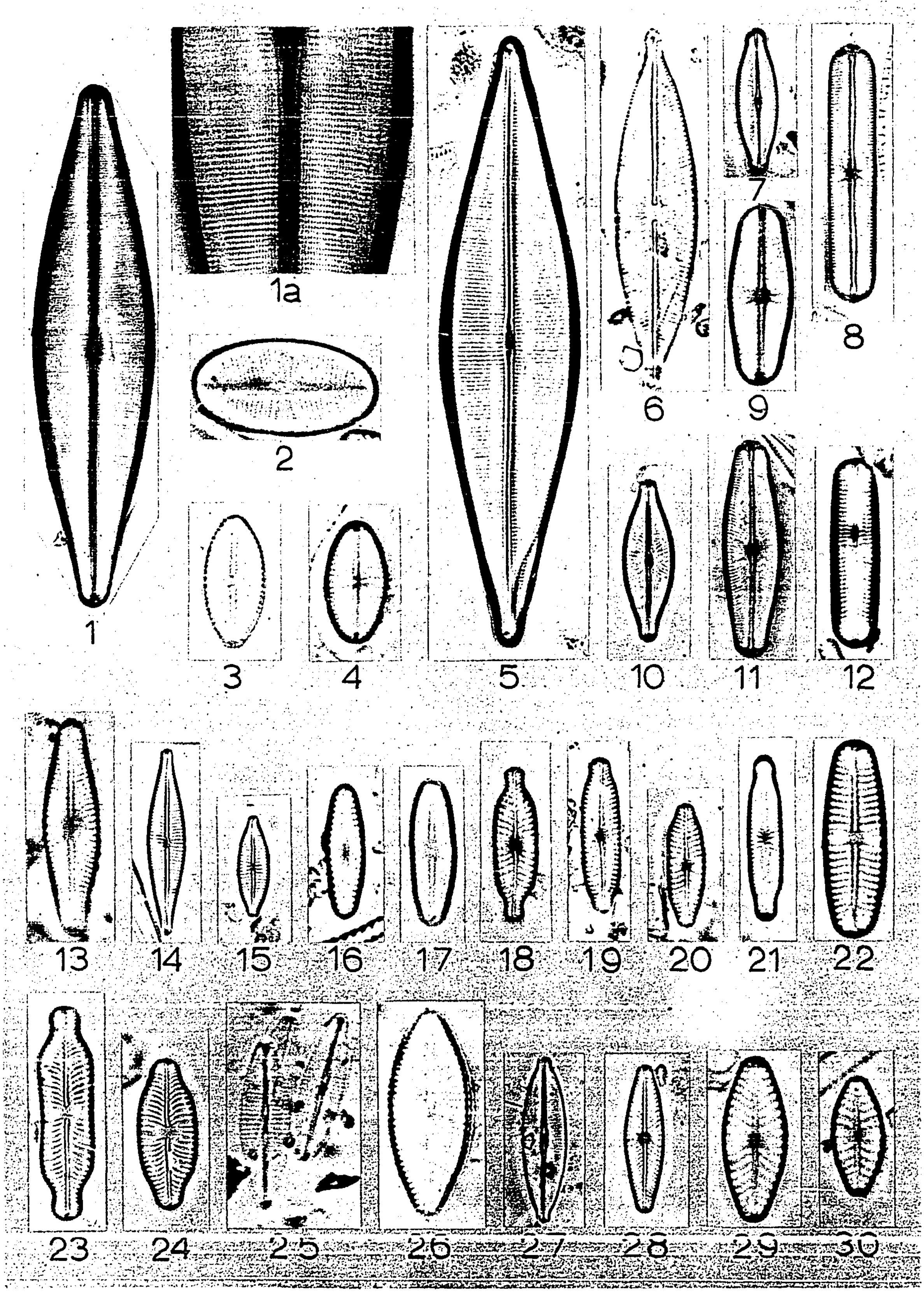
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Plate XII

Fig. 1- 2. Navicula stroesei var. stroesei X1000 p. 95.
Fig. 3. Navicula tuscula var. tuscula X1000 p. 96.
Fig. 4. Navicula tuscula f. minor X2000 p. 96.
Fig. 5. Navicula placentula var. placentula X1000 p. 90.
Fig. 6. Navicula placentula var. rostrata X1000 p. 91.
Fig. 7. Navicula elata var. elata X1000 p. 85.
Fig. 8. Navicula explanata var. explanata X1000 p. 85.
Fig. 9. Navicula anglica var. anglica X2000 p. 80.
Fig. 10. Navicula disjuncta var. disjuncta X2000 p. 85.
Fig. 11. Navicula decussis var. decussis X1000 p. 84.
Fig. 12. Navicula capitata var. capitata X1000 p. 81.
Fig. 13. Navicula capitata var. hungarica X1000 p. 81.
Fig. 14. Navicula bacillum var. bacillum X1000 p. 80.
Fig. 15. Gomphonema parvulum var. parvulum X2000 p. 72.
Fig. 16. Gomphonema parvulum var. micropus X1000 p. 73.
Fig. 17-18. Gomphonema angustatum var. angustatum X1000 p. 66.
Fig. 19-20. Gomphonema angustatum var. sarcophagus X1000 p. 67.
Fig. 21. Gomphonema olivaceum var. olivaceum X1000 p. 72.
Fig. 22. Gomphonema olivaceoides var. olivaceoides X1000 p. 71.
Fig. 23. Gomphonema carolinense var. carolinense X1000 p. 67.
Fig. 24. Gomphonema constrictum var. constrictum X1000 p. 68.
Fig. 25. Gomphonema constrictum var. subcapitata X1000 p. 68.
Fig. 26. Gomphonema constrictum var. capitata X1000 p. 68.
Fig. 27. Gomphonema constrictum f. parva X1000 p. 68.
Fig. 28. Gomphonema sphaerophorum var. sphaerophorum X1000 p. 73.
Fig. 29. Gomphonema subtile var. subtile X1000 p. 74.
Fig. 30. Gomphonema acuminatum var. acuminatum X1000 p. 66.
Fig. 31. Gomphonema acuminatum var. elongata X1000 p. 66.
Fig. 32-34. Gomphonema acuminatum var. brebissonii X1000 p. 66.
Fig. 35. Gomphonema tenellum var. tenellum X2000 p. 74.
Fig. 36-37. Gomphonema montanum var. subclavata X1000 p. 71.

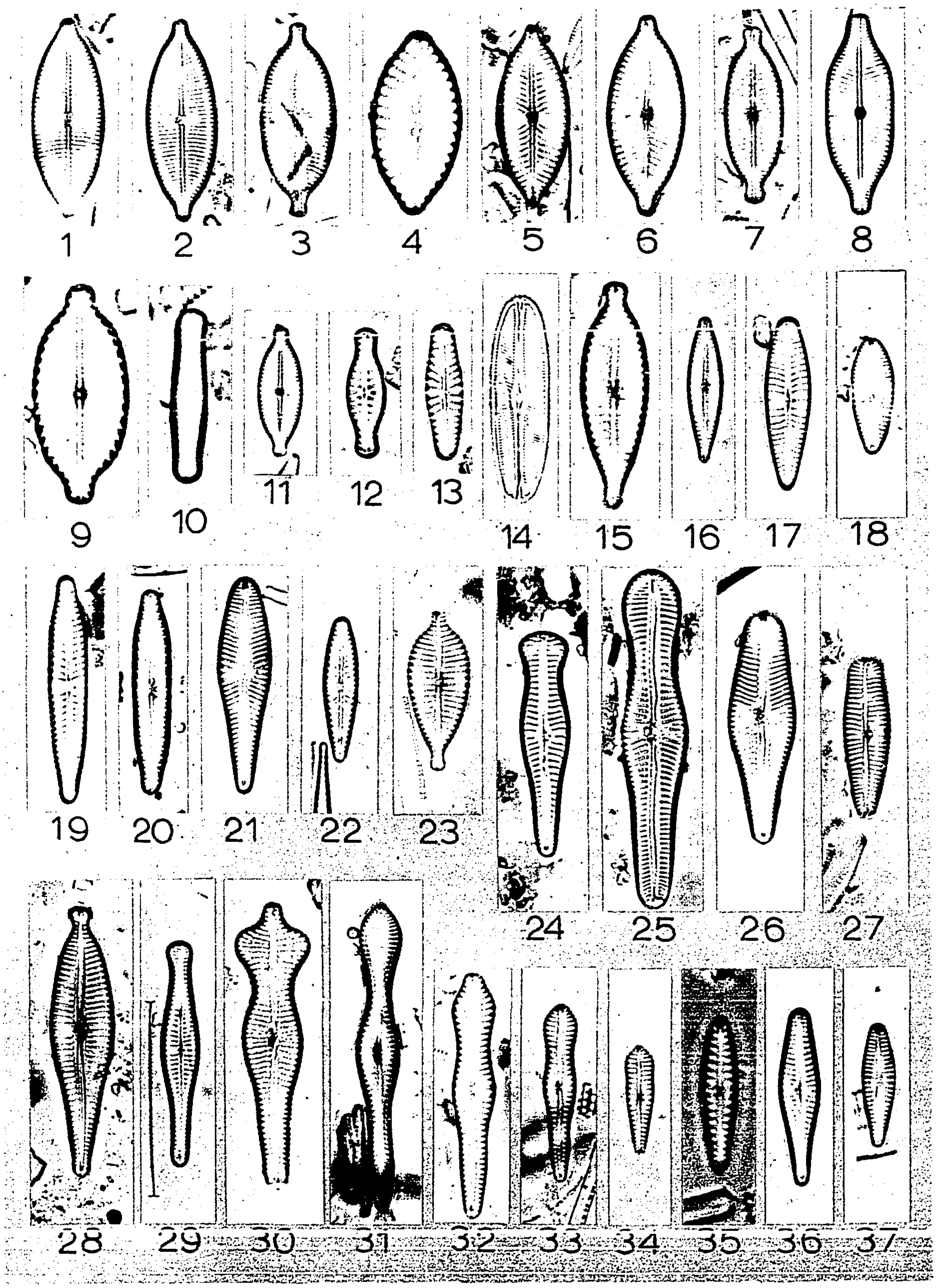
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Plate XIII

Fig. 1. *Gomphonema insigne* var. *insigne* X1000 p. 70.
Fig. 2- 3. *Gomphonema insigne* var. *elongatum* X1000 p. 70.
Fig. 4- 5. *Gomphonema turris* var. *turris* X1000 p. 74.
Fig. 6- 7. *Gomphonema subclavatum* var. *subclavatum* X1000 p. 73.
Fig. 8. *Gomphonema subclavatum* var. *mexicanum* X1000 p. 74.
Fig. 9. *Gomphonema intricatum* var. *intricatum* X1000 p. 70.
Fig. 10-11. *Gomphonema intricatum* var. *vibrio* X1000 p. 71.
Fig. 12. *Gomphonema intricatum* var. *pumila* X1000 p. 70.
Fig. 13. *Gomphonema gracile* var. *aurita* X1000 p. 69.
Fig. 14. *Gomphonema gracile* var. *lanceolata* X1000 p. 69.
Fig. 15. *Gomphonema gracile* var. *naviculoides* X1000 p. 69.
Fig. 16-17. *Gomphonema gracile* var. ? X1000 p. 69.
Fig. 18. *Hantzschia amphioxys* var. *amphioxys* X1000 p. 75.
Fig. 19. *Hantzschia amphioxys* var. *maior* X1000 p. 76.
Fig. 20. *Hantzschia amphioxys* var. *vivax* X500 p. 76.
Fig. 21. *Epithemia sorex* var. *sorex* X1000 p. 59.
Fig. 22. *Epithemia zebra* var. *saxonica* X1000 p. 60.

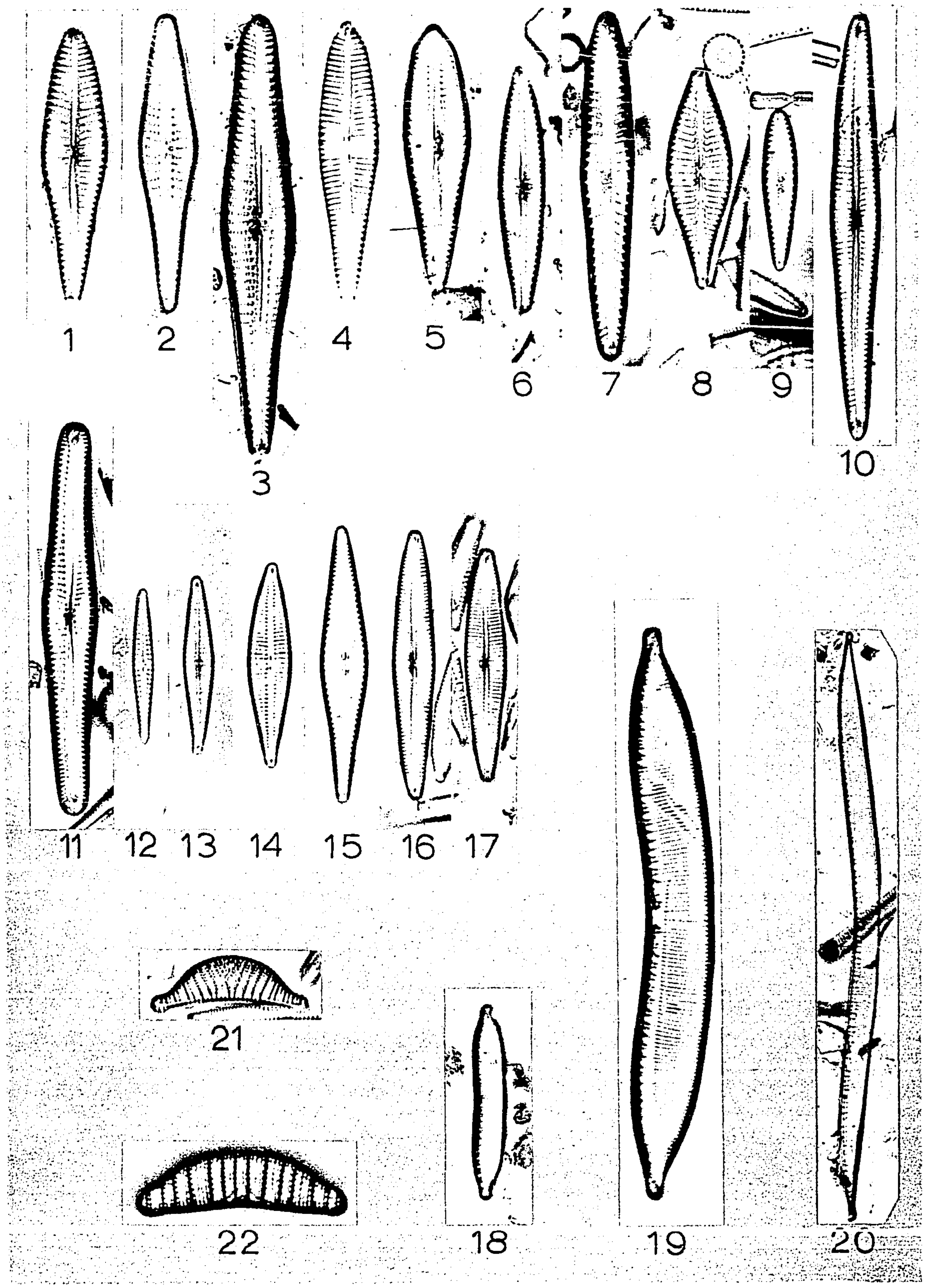
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Plate XIV

Fig. 1- 1a. Epithemia turgida var. turgida (post-auxospore) X500 and X1000 respectively p. 59.
Fig. 2- 6. Epithemia turgida var. turgida X1000 p. 59.
Fig. 7. Nitzschia parvula var. terricola X1000 p. 108.
Fig. 8. Nitzschia angustata var. acuta X1000 p. 103.
Fig. 9. Nitzschia angustata var. angustata X1000 p. 102.
Fig. 10. Nitzschia sp. #4 X2000 p. 110.
Fig. 11. Nitzschia amphibia var. amphibia X1000 p. 102.
Fig. 12. Nitzschia valdestriata var. valdestriata X2000 p. 110.
Fig. 13-14. Nitzschia holsatica var. holsatica X1000 p. 105.
Fig. 15. Nitzschia commutata var. commutata X1000 p. 103.
Fig. 16. Nitzschia hungarica var. hungarica X1000 p. 106.
Fig. 17. Nitzschia recta var. recta X1000 p. 109.

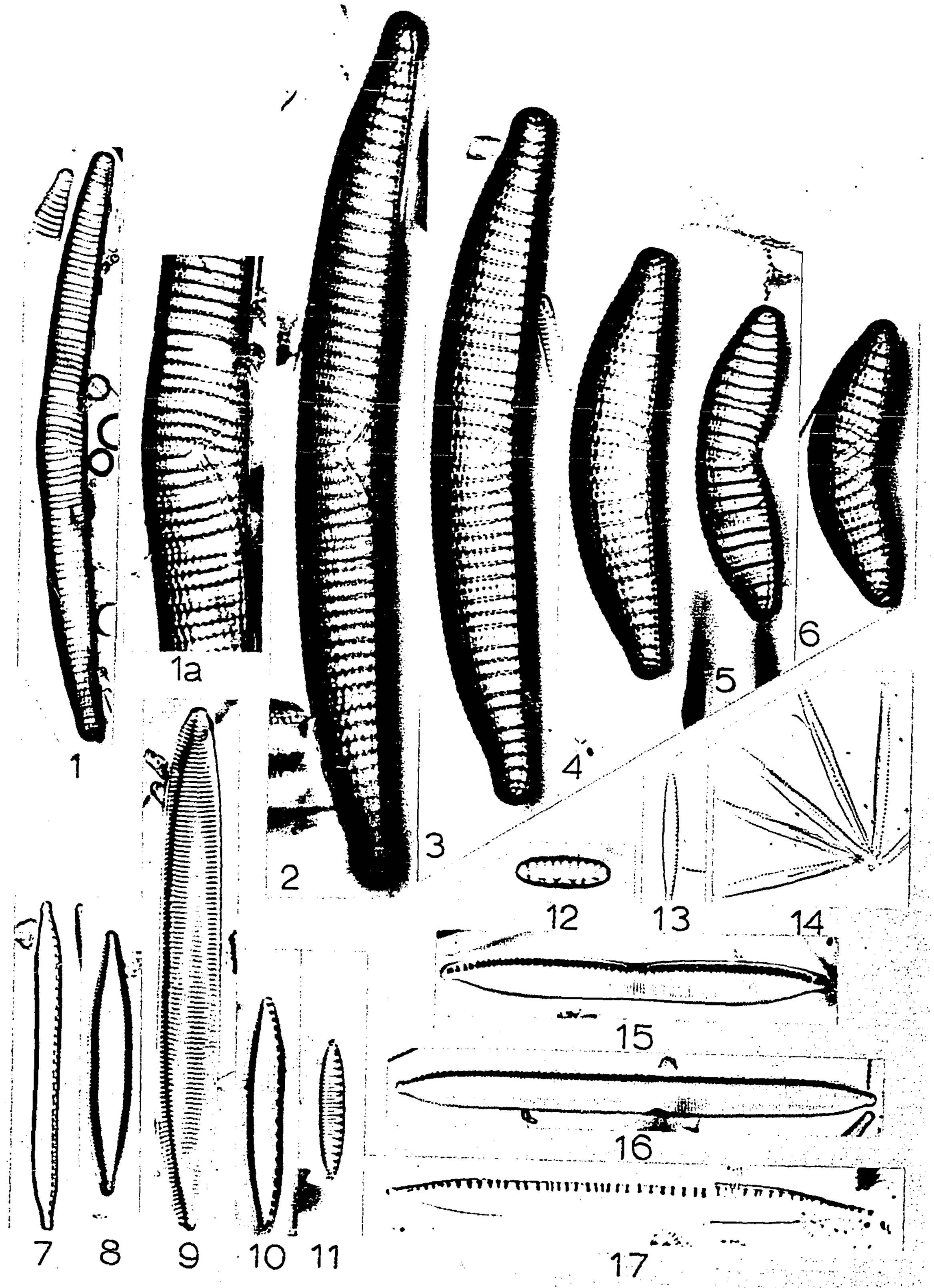
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Plate XV

Fig. 1- 1a. Nitzschia sigmoidea var. sigmoidea X500 and X1000 respectively p. 109.
Fig. 2. Nitzschia acuta var. acuta X1000 p. 102.
Fig. 3- 3a. Nitzschia linearis var. linearis X1000 p. 106.
Fig. 4- 4a. Nitzschia subtilioides var. subtilioides X1000 p. 109.
Fig. 5- 5a. Nitzschia lauenburgiana var. lauenburgiana X500 and X1000 respectively p. 106.
Fig. 6- 6a. Nitzschia tenuis var. tenuis X500 and X1000 respectively p. 110.
Fig. 7. Nitzschia philippinarum var. philippinarum X1000 p. 108.
Fig. 8. Nitzschia acicularioides var. ? X1000 p. 101.
Fig. 9-10. Nitzschia capitellata var. capitellata X1000 p. 103.
Fig. 11. Nitzschia pilum var. pilum X1000 p. 108.
Fig. 12. Nitzschia subrostratoides var. subrostratoides X1000 p. 109.
Fig. 13. Nitzschia sp. #13 X1000 p. 111.
Fig. 14. Nitzschia legleri var. legleri X1000 p. 106.
Fig. 15. Nitzschia fonticola var. fonticola X1000 p. 104.
Fig. 16. Nitzschia frustulum var. frustulum X1000 p. 104.
Fig. 17. Nitzschia tropica var. tropica X1000 p. 110.
Fig. 18. Nitzschia subrostrata var. subrostrata X1000 p. 109.
Fig. 19. Nitzschia palea var. palea X1000 p. 107.
Fig. 20. Nitzschia palea var. tropica X1000 p. 107.
Fig. 21. Nitzschia palea var. debilis X1000 p. 107.
Fig. 22. Nitzschia sp. #12 X1000 p. 110.

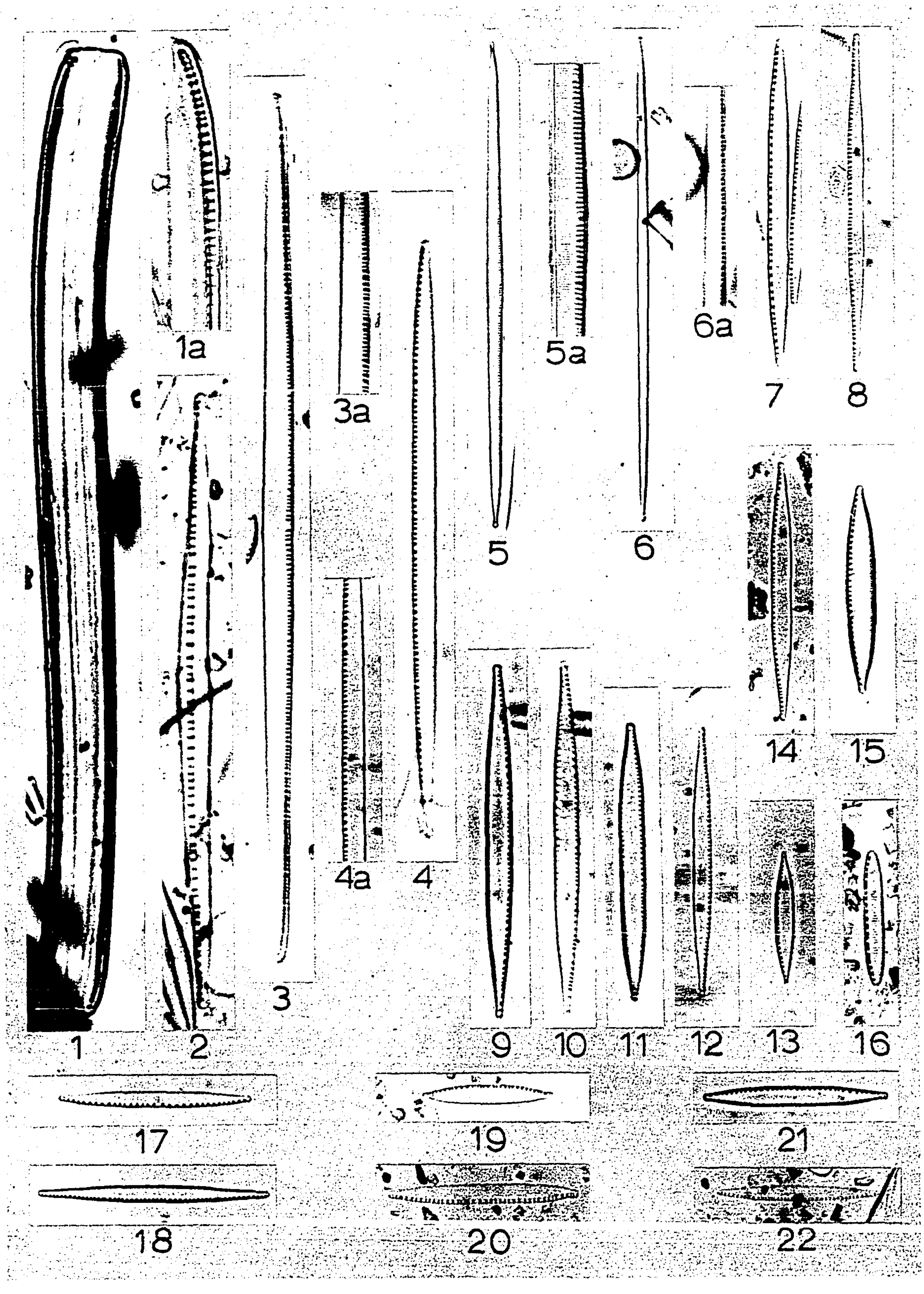
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Plate XVI

Fig. 1. *Nitzschia paleoides* var. *paleoides* X1000 p. 108.
Fig. 2. *Nitzschia acicularis* var. *acicularis* X1000 p. 102.
Fig. 3. *Nitzschia dissipata* var. *dissipata* X1000 p. 104.
Fig. 4. *Nitzschia debilis* var. *debilis* X1000 p. 103.
Fig. 5. *Nitzschia gracilis* var. *gracilis* X1000 p. 105.
Fig. 6. *Nitzschia graciloides* var. *graciloides* X1000 p. 105.
Fig. 7. *Nitzschia elegans* var. *elegans* X1000 p. 104.
Fig. 8. *Cymatopleura solea* var. *solea* X1000 p. 50.
Fig. 9. *Cymatopleura solea* var. *apiculata* X1000 p. 51.
Fig. 10. *Cymatopleura solea* var. *gracilis* X500 p. 51.
Fig. 11. *Cymatopleura cochlea* var. *cochlea* X1000 p. 50.
Fig. 12. *Surirella robusta* var. *robusta* X500 p. 119.

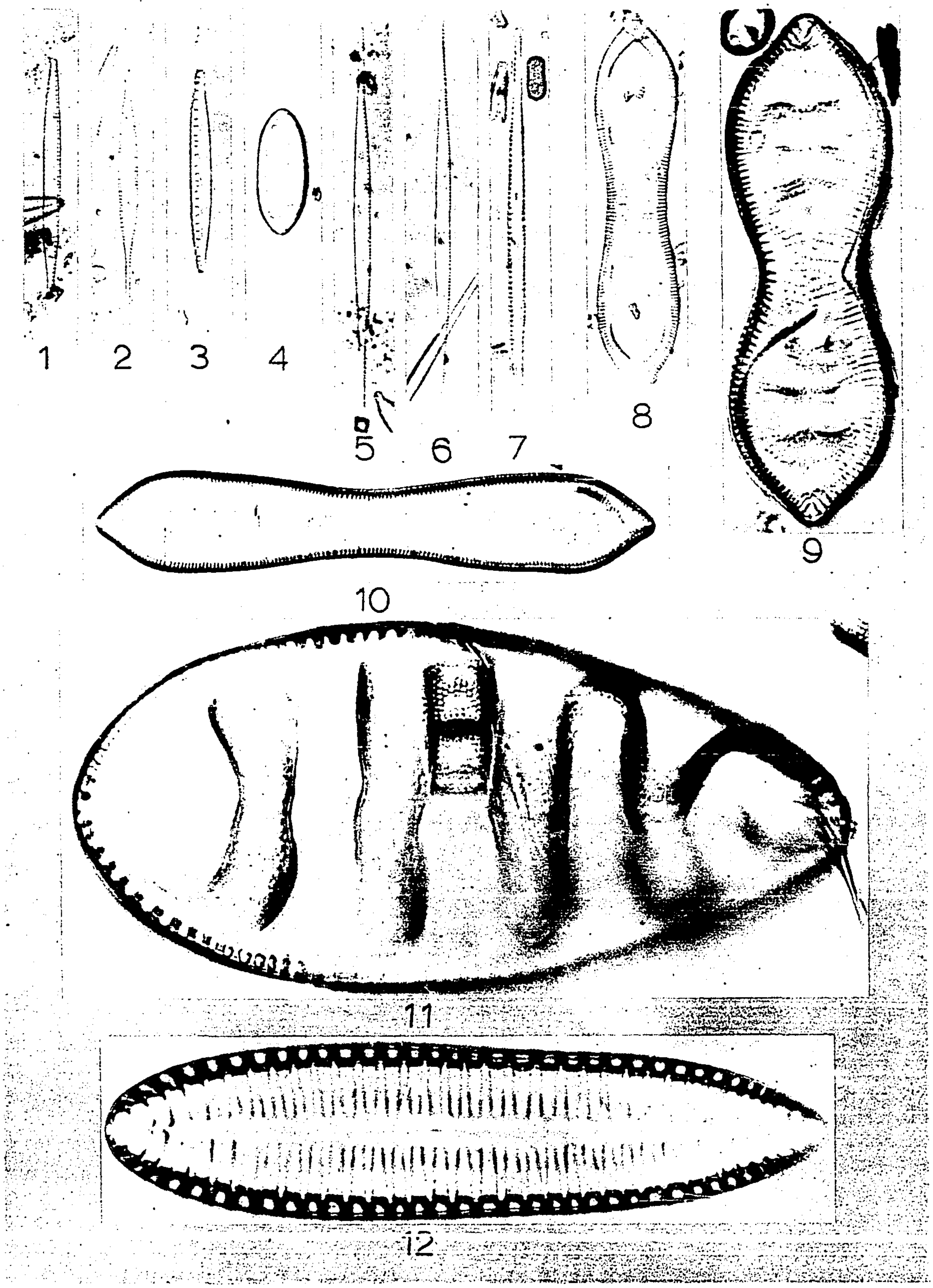
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Plate XVII

Fig.	1- 2.	Surirella biseriata f. punctata X1000 and X500 respectively p. 117.
Fig.	3.	Surirella tenera var. nervosa X500 p. 119.
Fig.	4.	Surirella linearis var. constricta X1000 p. 118.
Fig.	5.	Surirella linearis var. helvetica X500 p. 118.
Fig.	6.	Surirella kittoni var. kittoni X500 p. 118.
Fig.	7.	Surirella angusta var. angusta X1000 p. 117.
Fig.	8.	Surirella ovata var. ovata X1000 p. 118.
Fig.	9.	Surirella ovata var. pinnata X1000 p. 119.

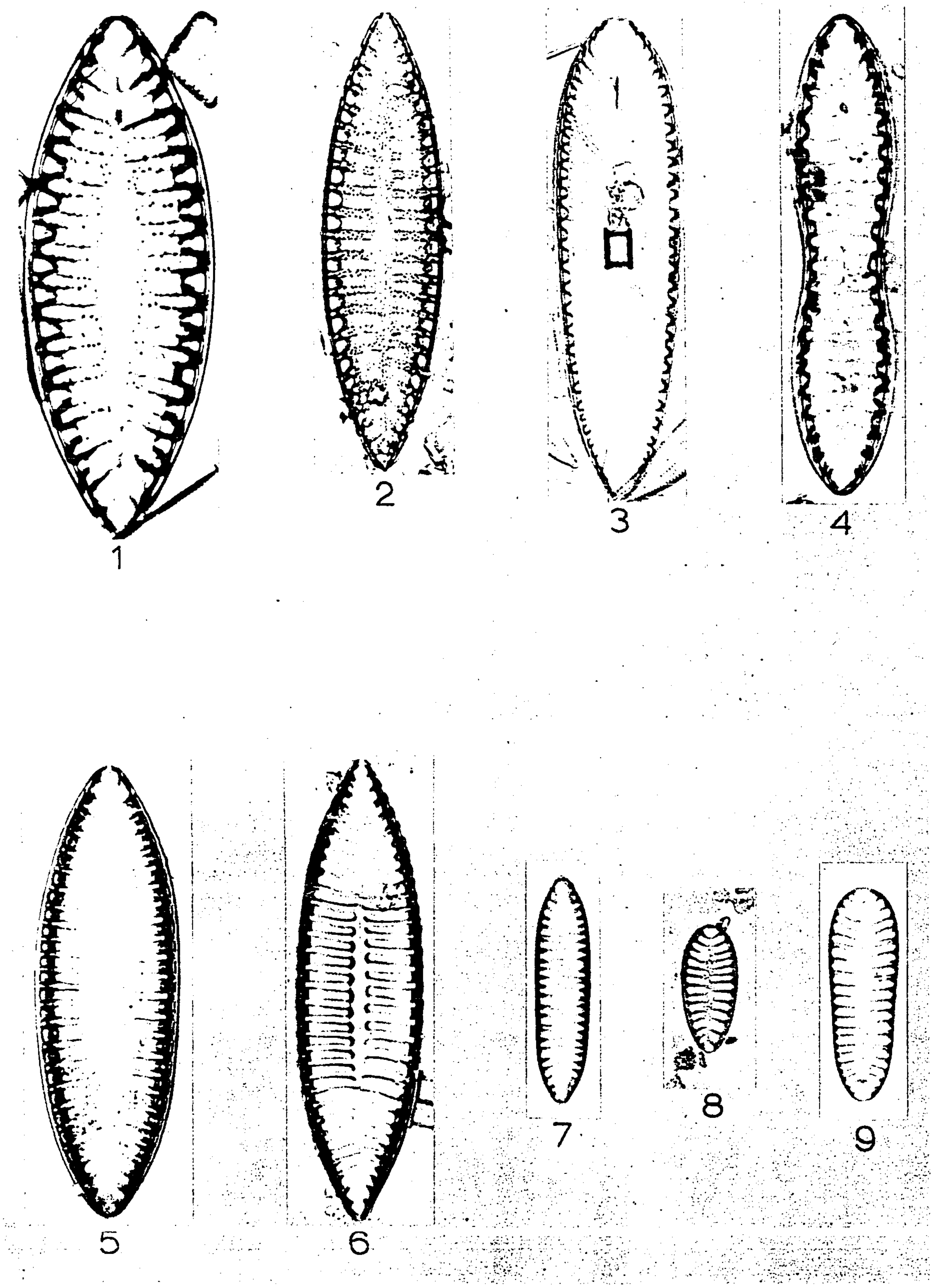
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Plate XVIII

Fig. 1a-l. _Navicula nigrii_ var. _nigrii_ X4000 (electron micrographs) p. 88.

Fig. 2a-l. _Navicula nigrii_ var. _nigrii_ X2000 (drawings prepared from Fig. 1a-l and Hyrax slides of same specimens--see also Pl. XI, Fig. 17) p. 88.

Fig. 3. _Navicula confervacea_ var. _confervacea_ (prepared from electron micrograph--see also Pl. XI, Fig. 26) p. 82.

Fig. 4. _Navicula bryophila_ var. _bryophila_ (prepared from electron micrograph--see also Pl. XI, Fig. 21) p. 80.

Fig. 5. _Navicula peratomus_ var. _peratomus_ p. 90.

Fig. 6. _Navicula pseudomatomus_ var. _pseudomatomus_ p. 91.

Fig. 7. _Navicula subarvensoides_ var. _subarvensoides_ p. 95.

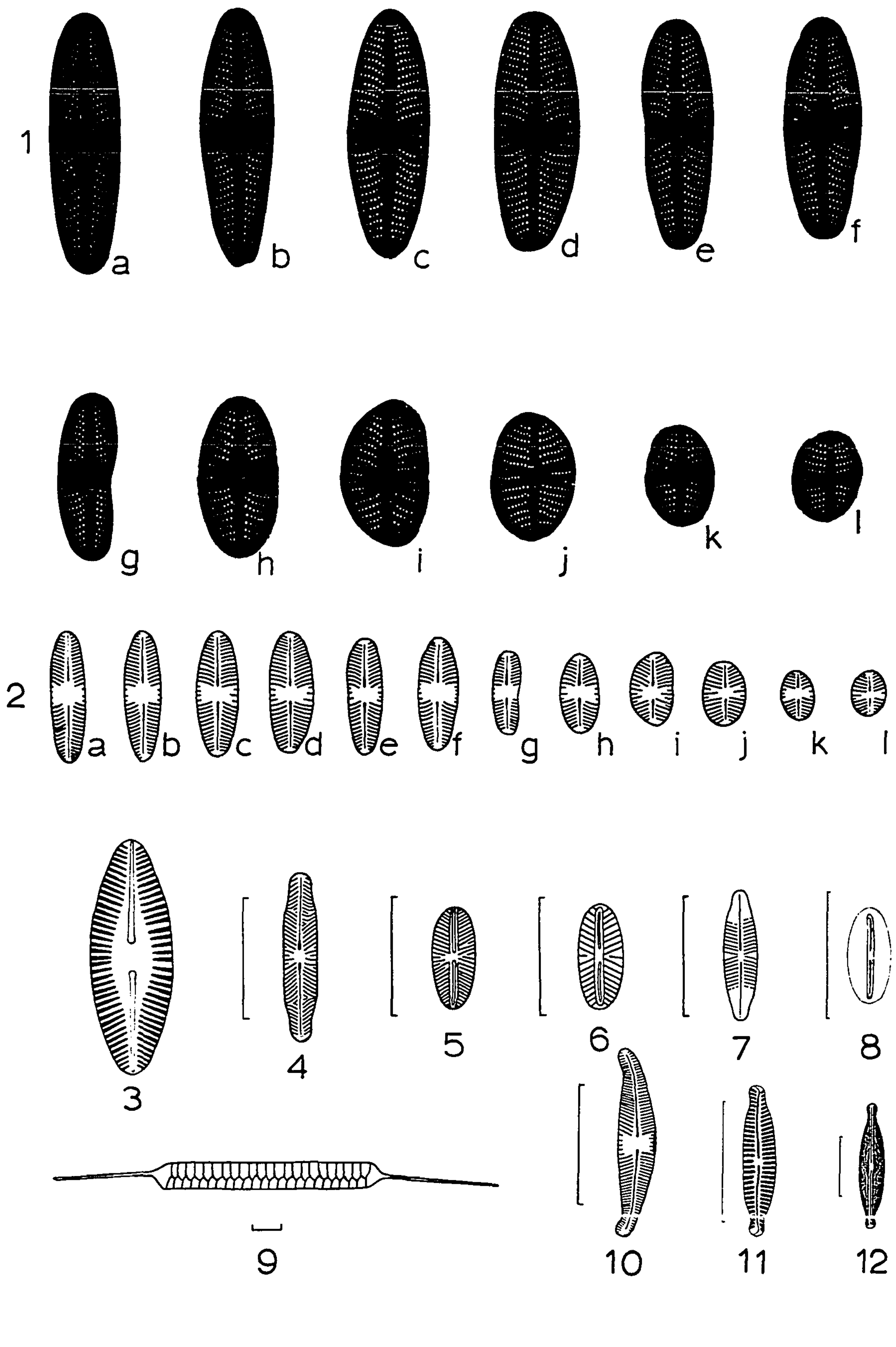
Fig. 8. _Navicula pelliculosa_ var. _pelliculosa_ (prepared from electron micrograph) p. 90.

Fig. 9. _Rhizosolenia eriensis_ var. _eriensis_ p. 114.

Fig. 10. _Amphora submontana_ var. _submontana_ (prepared from electron micrograph) p. 43.

Fig. 11. _Cymbella microcephala_ var. _microcephala_ (prepared from electron micrograph--see also Pl. VIII, Fig. 24) p. 54.

Fig. 12. _Anomoeoneis vitrea_ var. _vitrea_ (prepared from electron micrograph--see also Pl. V, Fig. 9) p. 44.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Tropidoneis P. T. Cleve

Tropidoneis lepidoptera var. proboscidea P. T. Cleve Pl. III, Fig. 18, Slide #89-1.

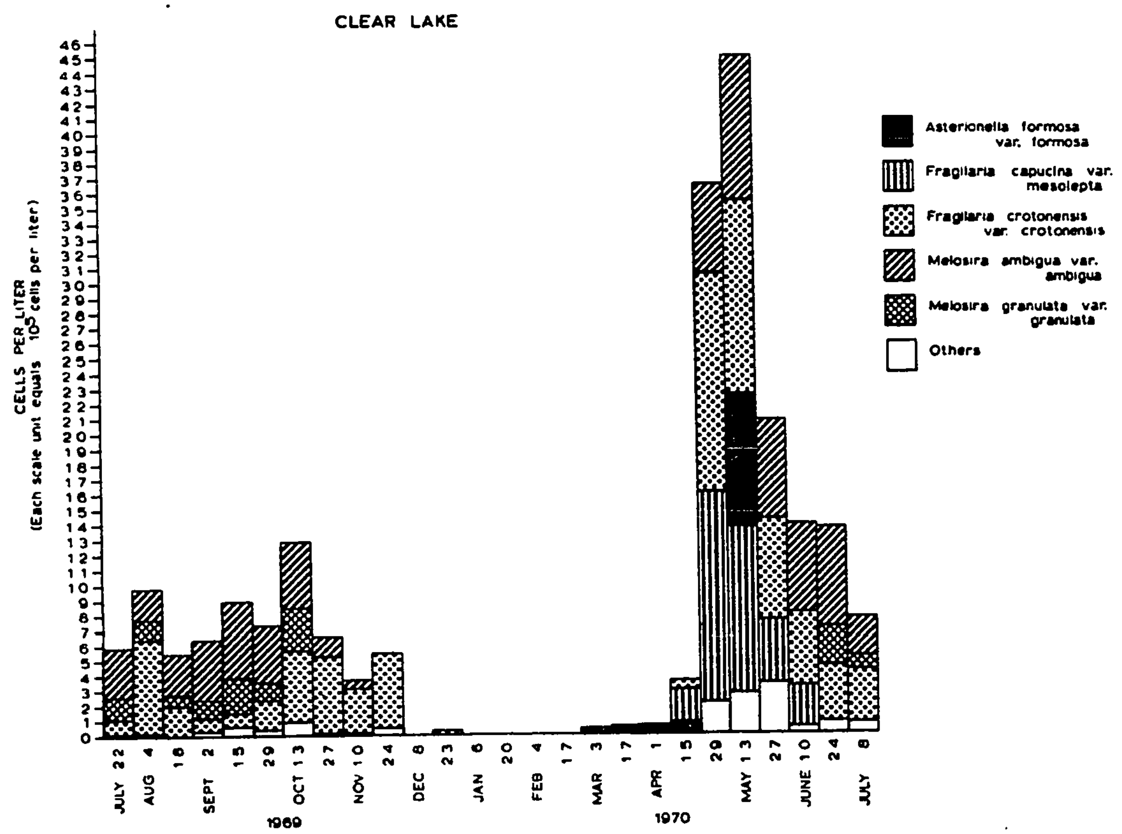
Critical reference: Stoermer 1964, p. 65, Pl. 5, Fig. 2.

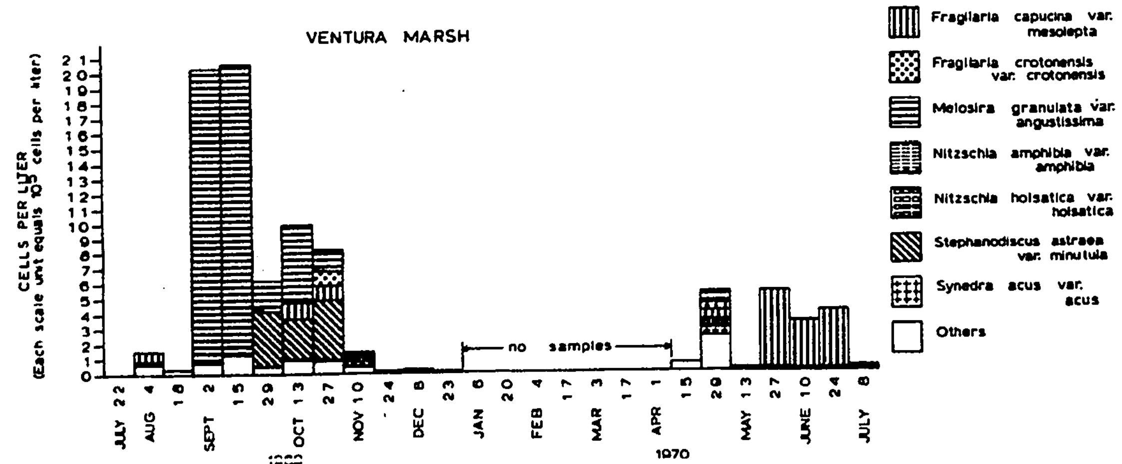
Rare in three Clear Lake samples. In scrapings of rocks from 30 cm water at station 10 (24 June 1969), in the plankton at station 8 (29 September 1969), and scrapings from old tires on public dock at station 18 (4 August 1969).

Periodicity in the Plankton

The total standing crop of planktonic diatoms (net plankton) for each biweekly sampling date, as well as the standing crops of some of the more numerically significant planktonic taxa, are presented graphically in Figure 4. A vernal and autumnal pulse and a hibernal minimum were apparent in each study area. In Clear Lake, the vernal maximum (4.5×10^6 cells/liter on 13 May 1970) was greater than the autumnal maximum (1.3×10^6 cells/liter on 13 October 1969) while the autumnal maximum (2.1×10^6 cells/liter on 15 September 1969) was greater than the vernal maximum (5.3×10^5 on both 29 April 1970 and 27 May 1970) in Ventura Marsh. The vernal pulse was more sharply defined than the autumnal pulse in the lake, but the opposite appeared to be true in the marsh. Pennate diatoms predominated the vernal pulses and centric diatoms predominated the autumnal pulses in both study areas. However, one centric diatom (Melosira ambigua var. ambigua) and one pennate diatom (Fragilaria crotonensis var. crotonensis) were major contributors to both

Figure 4. Biweekly standing crop of planktonic diatoms (net plankton) of Clear Lake and Ventura Marsh


CLEAR LAKE
CELLS PER LITER
(Each scale unit equals 10^5 cells per liter)
JULY 22
AUG 4
18
SEPT 2
15
29
OCT 13
27
NOV 10
24
DEC 8
23
JAN 6
20
FEB 4
17
MAR 3
17
APR 1
15
29
MAY 13
27
JUNE 10
24
JULY 8
1969
1970
Asterionella formosa var. formosa
Fragilaria capucina var. mesolepta
Fragilaria crotonensis var. crotonensis
Melosira ambigua var. ambigua
Melosira granulata var. granulata
Others


VENTURA MARSH
CELLS PER LITER
(Each scale unit equals 10^5 cells per liter)
no samples
JULY 22
AUG 4
18
SEPT 2
15
29
OCT 13
27
NOV 10
24
DEC 8
23
JAN 6
20
FEB 4
17
MAR 3
17
APR 1
15
29
MAY 13
27
JUNE 10
24
JULY 8
1970
Fragilaria capucina var. mesolepta
Fragilaria crotonensis var. crotonensis
Melosira granulata var. angustissima
Nitzschia amphibia var. amphibia
Nitzschia holsatica var. holsatica
Stephanodiscus astraea var. minutula
Synedra acus var. acus
Others

the vernal and the autumnal pulse in Clear Lake.

The winter minimum in the lake appeared to correspond with the period when the lake was covered with both ice and snow (8 December 1969 to 17 February 1970). The marsh plankton also declined rapidly with the onset of winter, but no observations could be made after 23 December 1969 since the marsh was frozen to within a few centimeters of the bottom at the sampling station by early January.

Periodicity in Non-plankton Habitats

No attempt was made to quantify the standing crop of non-planktonic diatoms. However, a few general comments concerning the relative abundance of these forms in Clear Lake are possible. Like the planktonic forms, the *Aufwuchs* and surface sediment diatoms of the lake produced much smaller standing crops during the winter months than at other times of the year. This was particularly true when the lake was covered with both ice and snow. A spring pulse of *Aufwuchs* and surface sediment diatoms was also observed. On 17 March 1970 every substrate at station 8 was covered with massive growths of diatoms, primarily *Fragilaria capucina* var. *mesolepta* and *Gomphonema olivaceum* var. *olivaceum*. On the previous sampling date (3 March 1970) this area was covered with 51 cm ice and no massive growths of diatoms were observed. On the sampling date following this pulse (1 April 1970), the massive growths were no longer present. Thus, the *Aufwuchs* and surface sediment diatom pulse appeared just after the ice melted and disappeared before the spring planktonic diatom bloom. A similar, but less dramatic, pulse of *Aufwuchs* and surface sediment diatoms was observed in the fall. The fall pulses were observed in November (just before ice formation) and were composed primarily of growths of Fragilaria capucina var. mesolepta and F. crotonensis var. crotonensis on a variety of substrates. No obvious pulses of Aufwuchs or surface sediment diatoms were observed in the marsh.

Although the standing crop of Aufwuchs and surface sediment diatoms was small when the lake was covered by ice and snow, some taxa appeared to be fairly productive under these conditions. The following taxa were abundant to very abundant, from the standpoint of proportional counts, when the lake was covered with ice and snow, but also reached such frequencies during other seasons:

Achnanthes minutissima var. minutissima
Cocconeis placentula var. lineata
Fragilaria capucina var. mesolepta
Fragilaria crotonensis var. crotonensis

Gomphonema olivaceoides var. olivaceoides and Cymbella affinis var. affinis were abundant to very abundant only when the lake was ice- and snow-covered. Increased occurrences of auxospores were also noted when the lake was ice- and snow-covered. On 17 February 1970, numerous auxospores of Cymbella affinis var. affinis, Cymbella cistula var. cistula, and Achnanthes minutissima var. minutissima were observed in scrapings of rocks, but large numbers of auxospores were not observed at other times of the year.

Communities and Habitats

Approximately 300 diatom valves were identified and counted from each Aufwuchs and surface sediment sample and 1000 valves from each quantitative plankton sample. The results of these counts have been previously considered from the standpoint of the autecology of the individual taxa. Observations on the diatom communities of the various major habitats and the communities of a few interesting individual samples follow.

Thirty epiphytic samples were collected from the lake and 26 from the marsh. Table 5 lists the taxa frequently encountered as epiphytes as well as those taxa which, though less frequently encountered, appeared to prefer plant substrates.

Table 5. Taxa observed in at least 50% of the epiphytic samples from Clear Lake and/or Ventura Marsh (X) or found in fewer samples, but appearing to prefer plant substrates (P)

Taxon	Clear Lake	Ventura Marsh
Achnanthes hungarica var. hungarica		P
Achnanthes lanceolata var. lanceolata		X
Achnanthes minutissima var. minutissima	X	
Amphipleura pellucida var. pellucida	X	
Amphora ovalis var. pediculus	X	
Amphora submontana var. submontana		P
Cocconeis pediculus var. pediculus	P	
Cocconeis placentula var. lineata	P	X
Cocconeis placentula var. placentula	P	P
Cymbella caespitosum var. caespitosum	X	
Cymbella microcephala var. microcephala	X	
Cymbella turgida var. pseudogracilis	X	
Epithemia turgida var. turgida		P
Eunotia curvata var. curvata		P
Fragilaria capucina var. capucina	X	
Fragilaria capucina var. mesolepta	X	
Fragilaria crotonensis var. crotonensis	X	
Fragilaria pinnata var. lancettula	X	
Fragilaria vaucheriae var. vaucheriae	X	
Gomphonema angustatum var. angustatum		P
Gomphonema constrictum var. constrictum		P
Gomphonema constrictum var. capitatum		P
Gomphonema gracile var. lanceolata		P
Gomphonema intricatum var. pumila	P	
Gomphonema intricatum var. vibrio		P
Gomphonema montanum var. subclavata		X
Gomphonema parvulum var. micropus		P

Table 5. (Continued)

Taxon	Clear Lake	Ventura Marsh
Gomphonema parvulum var. parvulum		X
Gomphonema subclavatum var. mexicanum		P
Melosira ambigua var. ambigua	X	
Melosira granulata var. granulata	X	
Navicula cryptocephala f. minuta	X	
Navicula radiosa var. tenella	X	
Navicula salinarum var. intermedia	X	
Navicula subarvensoides var. subarvensoides		P
Navicula tantula var. tantula		P
Nitzschia amphibia var. amphibia		X
Nitzschia capitellata var. capitellata		P
Nitzschia dissipata var. dissipata	X	
Nitzschia palea var. palea		P
Nitzschia palea var. debilis		P
Nitzschia paleoides var. paleoides		P
Nitzschia tropica var. tropica	X	X
Rhopalodia gibba var. gibba		P

Thirteen surface sediment samples were collected from the lake and 11 from the marsh. Table 6 lists the taxa frequently encountered in these samples as well as those taxa which, though less frequently encountered, appeared to prefer surface sediment habitats.

Table 6. Taxa observed in at least 50% of the surface sediment samples from Clear Lake and/or Ventura Marsh (X) or found in fewer samples, but appearing to prefer an epipelic existence (P)

Taxon	Clear Lake	Ventura Marsh
Achnanthes exigua var. heterovalva	P	
Achnanthes hungarica var. hungarica		X
Achnanthes lanceolata var. lanceolata	X	X
Achnanthes minutissima var. minutissima	X	
Amphora ovalis var. libyca		X
Amphora ovalis var. pediculus	X	
Amphora veneta var. veneta		X

Table 6. (Continued)

Taxon	Clear Lake	Ventura Marsh
Caloneis clevei var. uruguayensis		P
Caloneis lewisii var. lewisii		P
Cocconeis placentula var. lineata		X
Cyclotella meneghiniana var. meneghiniana		X
Cymbella caespitosum var. caespitosum	X	
Cymbella microcephala var. microcephala	X	
Eunotia curvata var. curvata		X
Eunotia formica var. formica		P
Fragilaria brevistriata var. brevistriata		X
Fragilaria capucina var. capucina		X
Fragilaria capucina var. mesolepta	X	
Fragilaria construens var. construens	X	
Fragilaria construens var. venter	X	
Fragilaria crotonensis var. crotonensis	X	
Fragilaria pinnata var. lancettula	X	
Fragilaria vaucheriae var. vaucheriae	X	X
Fragilaria virescens var. virescens		X
Gomphonema angustatum var. sarcophagus		P
Gomphonema carolinense var. carolinense		P
Gomphonema parvulum var. parvulum		X
Hantzschia amphioxys var. amphioxys		P
Melosira ambigua var. ambigua	X	
Melosira granulata var. granulata	X	
Navicula anglica var. anglica	P	
Navicula confervacea var. confervacea		P
Navicula pupula var. rectangularis		X
Navicula viridula var. argunensis		X
Nitzschia amphibia var. amphibia		X
Nitzschia dissipata var. dissipata	X	
Nitzschia frustulum var. frustulum		X
Nitzschia legleri var. legleri	P	
Opephora martyi var. martyi	P	
Pinnularia brebissonii var. brebissonii		X
Stephanodiscus niagarae var. niagarae	X	
Synedra acus var. acus		X

Epilithic samples were collected only from the lake. The few rocks I was able to find in the marsh were heavily silted over and did not represent typical epilithic habitats. The following taxa were observed in at least 50% of the 32 epilithic samples from Clear Lake:

Achnanthes minutissima var. *minutissima*
Amphora ovalis var. *pediculus*
Cymbella affinis var. *affinis*
Cymbella caespitosum var. *caespitosum*
Cymbella microcephala var. *microcephala*
Fragilaria capucina var. *capucina*
Fragilaria capucina var. *mesolepta*
Fragilaria crotonensis var. *crotonensis*
Fragilaria vaucheriae var. *vaucheriae*
Gomphonema olivaceum var. *olivaceum*
Melosira ambigua var. *ambigua*
Melosira granulata var. *granulata*
Navicula cryptocephala f. *minuta*
Navicula radiosa var. *tenella*
Navicula salinarum var. *intermedia*
Nitzschia dissipata var. *dissipata*
Nitzschia tropica var. *tropica*
Synedra acus var. *acus*

The following taxa appeared to prefer rock substrates, but were observed in fewer lake samples than those listed above:

Fragilaria crotonensis var. *prolongata*
Fragilaria vaucheriae var. *capitellata*
Gomphonema olivaceoides var. *olivaceoides*
Mastogloia grevillei var. *grevillei*
Navicula bryophila var. *bryophila*
Navicula reinhardtii var. *reinhardtii*

Twenty-six quantitative plankton samples were collected from the lake and 19 from the marsh. Table 7 lists the taxa frequently encountered as plankters as well as those taxa which, though less frequently encountered, appeared to prefer a planktonic existence.

Table 7. Taxa observed in at least 50% of the quantitative plankton samples from Clear Lake and/or Ventura Marsh (X) or found in fewer samples, but appearing to prefer a planktonic existence (P)

Taxon	Clear Lake	Ventura Marsh
Achnanthes lanceolata var. lanceolata---------------		X

Table 7. (Continued)

Taxon	Clear Lake	Ventura Marsh
Asterionella formosa var. formosa	X	P
Cocconeis placentula var. lineata		X
Cyclotella meneghiniana var. meneghiniana		X
Cymatopleura cochlea var. cochlea	P	
Fragilaria capucina var. mesolepta	X	X
Fragilaria crotonensis var. crotonensis	X	P
Fragilaria vaucheriae var. vaucheriae		X
Gomphonema parvulum var. parvulum		X
Melosira ambigua var. ambigua	X	P
Melosira granulata var. granulata	X	
Melosira granulata var. angustissima	P	X
Navicula capitata var. hungarica		X
Navicula cryptocephala var. cryptocephala		X
Navicula cuspidata var. cuspidata		P
Nitzschia acicularis var. acicularis	P	P
Nitzschia amphibia var. amphibia		X
Nitzschia holsatica var. holsatica		P
Nitzschia tropica var. tropica		X
Nitzschia sp. #13		P
Rhizosolenia eriensis var. eriensis	P	
Stephanodiscus astraea var. minutula		X
Stephanodiscus invisitatus var. invisitatus	P	
Stephanodiscus niagarae var. niagarae	X	P
Synedra rumpens var. fragilarioides	P	

The following taxa were found in all three scrapings of dock pilings from Clear Lake:

Achnanthes minutissima var. minutissima
Amphora ovalis var. pediculus
Cymbella caespitosum var. caespitosum
Cymbella microcephala var. microcephala
Fragilaria vaucheriae var. vaucheriae
Melosira ambigua var. ambigua
Melosira granulata var. granulata
Navicula cryptocephala f. minuta
Navicula radiosa var. tenella
Nitzschia dissipata var. dissipata
Nitzschia tropica var. tropica

The following taxa were observed in all three marsh samples from wood substrates (one scraping of dock pilings and two scrapings of planks):

Cocconeis placentula var. lineata
Gomphonema parvulum var. parvulum
Navicula viridula var. argunensis
Nitzschia amphibia var. amphibia

Navicula nigrii var. nigrii was not observed in scrapings of dock pilings from the marsh, but was abundant in scrapings from one of the planks and very abundant in scrapings of the other plank.

Although only one psammon sample, number 48, was collected and examined from Clear Lake, this habitat is sufficiently interesting to merit brief consideration. The following taxa were observed in a count of 315 valves:

Achnanthes clevei var. clevei
Achnanthes clevei var. rostrata
Achnanthes lanceolata var. lanceolata
Achnanthes lanceolata var. dubia
Achnanthes lapponica var. ninckei
Achnanthes minutissima var. minutissima
Amphipleura pellucida var. pellucida
Amphora ovalis var. libyca
Amphora ovalis var. pediculus
Anomoeoneis vitrea var. vitrea
Asterionella formosa var. formosa
Cocconeis placentula var. placentula
Cocconeis sp. #2
Fragilaria capucina var. capucina
Fragilaria capucina var. mesolepta
Fragilaria construens var. construens
Fragilaria construens var. venter
Fragilaria crotonensis var. crotonensis
Fragilaria crotonensis var. prolongata
Fragilaria pinnata var. lancettula
Melosira ambigua var. ambigua
Melosira granulata var. granulata
Melosira granulata var. angustissima
Navicula cryptocephala var. veneta
Navicula decussis var. decussis
Navicula lanceolata var. lanceolata
Navicula menisculus var. obtusa
Navicula menisculus var. upsaliensis

Navicula platycephala var. platycephala
Navicula radiosa var. radiosa
Navicula reinhardtii var. reinhardtii
Navicula schoenfeldi var. schoenfeldi
Navicula vanheurckii var. vanheurckii
Nitzschia amphibia var. amphibia

Navicula platycephala var. platycephala was observed only in the psammon while Navicula decussis var. decussis and Navicula menisculus var. obtusa were more frequently encountered in the psammon than in any other habitat.

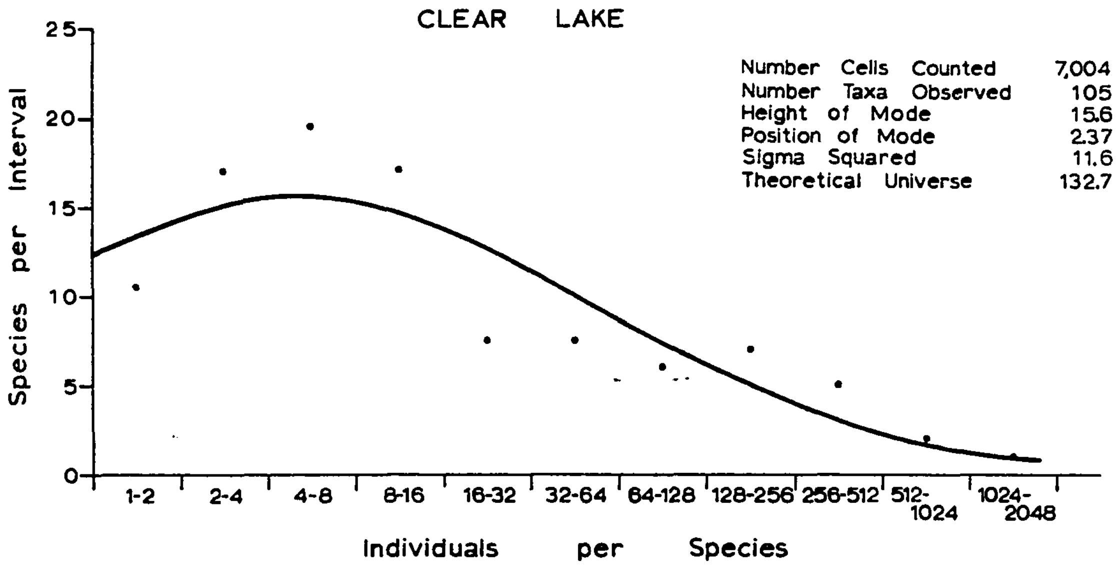
Since the water in the two drainage ditches (marsh stations III and IV) was highly enriched at the time collections were made, the diatom taxa which were well represented in these areas are of particular interest. The following taxa were common to very abundant in at least one of the samples collected from the ditches:

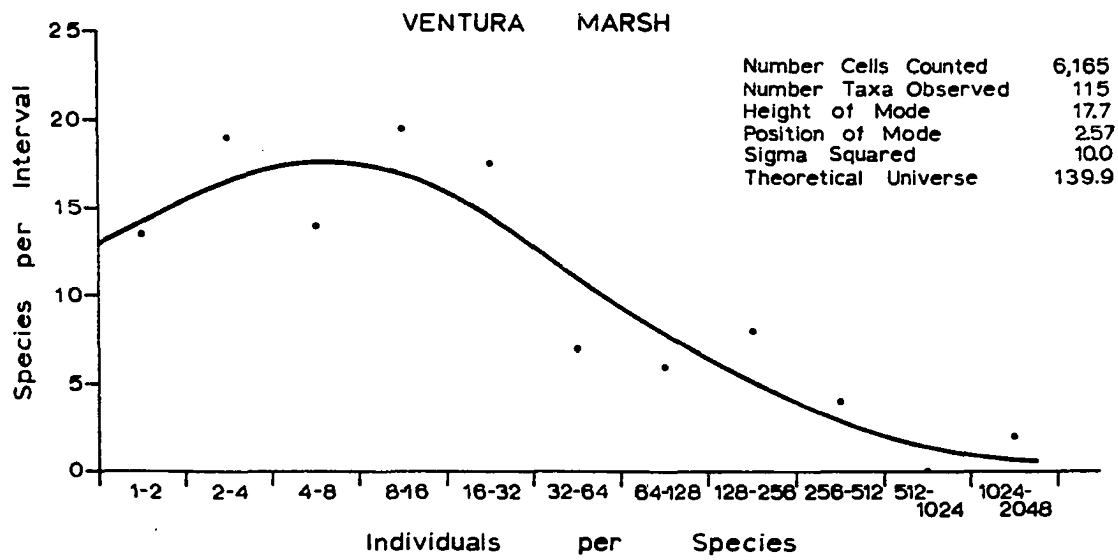
Achnanthes lanceolata var. lanceolata
Gomphonema angustatum var. angustatum
Meridion circulare var. circulare
Navicula nigrii var. nigrii
Nitzschia palea var. palea

Log-normal Distribution Data

Two composite samples containing subsamples from all the Aufwuchs and surface sediment samples collected from Clear Lake and Ventura Marsh, respectively, were prepared. A sufficient number of diatom valves from each of these samples were identified and enumerated to construct comparable log-normal curves for the two study areas, the mode being placed between the second and third intervals of the horizontal axis of both curves. These curves, as well as the parameters which determine the shapes of the curves, are presented in Figure 5. Since the heights of the modes, the theoretical universes, the numbers of intervals covered, the numbers of taxa observed, and the sigma squared values are similar for both curves, it appears that the structure of the two diatom communities is very similar.

Figure 5. Truncated log-normal curves from counts of composite samples from Clear Lake and Ventura Marsh


CLEAR LAKE
Number Cells Counted 7,004
Number Taxa Observed 105
Height of Mode 15.6
Position of Mode 2.37
Sigma Squared 11.6
Theoretical Universe 132.7
Species per Interval
0
5
10
15
20
25
1-2
2-4
4-8
8-16
16-32
32-64
64-128
128-256
256-512
512-1024
1024-2048
Individuals per Species


VENTURA MARSH
Number Cells Counted 6,165
Number Taxa Observed 115
Height of Mode 17.7
Position of Mode 2.57
Sigma Squared 10.0
Theoretical Universe 139.9
Species per Interval
0
5
10
15
20
25
1-2
2-4
4-8
8-16
16-32
32-64
64-128
128-256
256-512
512-1024
1024-2048
Individuals per Species

DISCUSSION

During the course of this study, 182 samples were collected and examined (117 from Clear Lake and 65 from Ventura Marsh). Some 95,000 diatom valves were identified and enumerated from these samples and many additional hours were devoted to scanning material from these samples in search of rare taxa. A total of 292 taxa (representing 36 genera) were encountered; 126 taxa were common to both the lake and the marsh while 98 were observed only in the lake and 68 only in the marsh. Clear Lake samples yielded 223 taxa from 35 genera and Ventura Marsh samples yielded 196 taxa from 28 genera.

The figures for Clear Lake compare well with the findings of Foged (1954). In his study of five eutrophic, alkaline lakes in Denmark, Foged found an average of 235 taxa from 34 genera (with a range of 209 to 260 taxa and 31 to 39 genera). Gandhi (1964) found only 173 taxa from 23 genera during his investigation of the alkaline Chandola Lake, but it appears that his study was less intense than the present one. Hustedt (1959a) reported what he considered to be a depauperate diatom flora from the Neusiedler See, 158 taxa representing 35 genera. This lake is similar to Clear Lake in that it is shallow eutrophic and alkaline; it differs in having high levels of sodium bicarbonate and sulfate compounds which Hustedt felt were responsible, in large part, for the small number of diatom taxa. Stoermer (1963a) reported 392 extant taxa representing 39 genera in his investigation of the flora of Lake West Okoboji, Iowa. Like Clear Lake, Lake West Okoboji is an alkaline, eutrophic lake. However, it is a deep (maximum depth 40.2 m, mean depth 12.3 m), stratifying lake and has a much greater variety of habitats than Clear Lake. Cleve-Euler (1932) reported 587 taxa representing 33 genera from the shallow, eutropic Takernsee, but 15 of her 141 samples were collected from habitats which cannot be considered part of the Tåkernsee proper. The Lunzer Untersee, an oligotrophic, alpine lake, was found to support no fewer than 319 taxa from 39 genera (Hustedt, 1922). Finally, Jurilj (1954) encountered 252 taxa from 40 genera in his investigation of the large, oligotrophic Ochrida Lake in Yugoslavia. From the above discussion, it becomes apparent that the simple numerical results of floristic studies, even when they appear to be comparable in scope and intensity, provide little information as to the number of taxa a particular type of lake can be expected to support. I have been unable to find any studies of the diatom floras of marshes which are closely comparable to the present study.

When the diatoms of Clear Lake and Ventura Marsh were considered collectively, Navicula, Nitzschia, Gomphonema, Neidium and Cymbella were represented by the greatest number of taxa (see Table 4). Navicula, Nitzschia, Gomphonema, Cymbella and Fragilaria were the most diverse genera in the lake while Navicula, Nitzschia, Gomphonema, Neidium and Pinnularia were represented by the greatest number of taxa in the marsh. In several cases, the number of taxa representing a genus differed considerably between the two study areas. Of particular significance in this regard are Achnanthes (10 lake taxa and five marsh taxa), Cyclotella (four lake taxa and one marsh taxon), Cymbella (19 lake taxa and four marsh taxa), Hantzschia (one lake taxon and three marsh taxa), and Surirella (seven lake taxa and three marsh taxa). Furthermore, members of the genus Meridion were not encountered in lake samples while Amphipleura, Diatoma, Gyrosigma, Mastogloia, Opephora, Rhizosolenia, Tabellaria and Tropidoneis appeared to be unrepresented in the marsh.

The major diatom communities considered in this study can be categorized as planktonic, epiphytic, epipelic and epilithic. Of these, the plankton community appeared to be the most productive in Clear Lake, but was probably less significant in Ventura Marsh. The phytoplankton of the lake, at least for the duration of the present study, corresponds to Hutchinson's (1967) phytoplankton type 8, eutrophic diatom plankton. The phytoplankton of the marsh is more difficult to place into Hutchinson's scheme since it appeared to be dominated by blue-green algae, especially Aphanizomenon flos-aquae (L.) Ralfs, during portions of the summer and by diatoms in the spring and fall.

The diatom taxa which were observed in at least 50% of the quantitative plankton samples from either the lake or the marsh or both study areas are listed in Table 7. If one considers the autecological comments (see Taxonomy and Autecology) for these taxa, it becomes apparent that many of the diatoms frequently encountered in the marsh plankton showed a preference for some other habitat and probably should be considered pseudoplankters. However, all the diatoms which were frequently encountered in the lake plankton appeared to be euplanktonic or at least meroplanktonic. Fragilaria capucina var. mesolepta appears to be a good example of a meroplanktonic diatom since it was a major contributor to the lake plankton from 15 April to 10 June, but also produced massive growths on a variety of substrates prior to its spring planktonic pulse. Furthermore, it appears that the massive growths of

F. capucina var. mesolepta on substrates provided a nucleus for the plankton bloom of that taxon which followed.

The quantitatively most significant plankters of Clear Lake are:

Asterionella formosa var. formosa
Fragilaria capucina var. mesolepta
Fragilaria crotonensis var. crotonensis
Melosira ambigua var. ambigua
Melosira granulata var. granulata

The quantitatively most significant plankters of Ventura Marsh are:

Fragilaria capucina var. mesolepta
Fragilaria crotonensis var. crotonensis
Melosira granulata var. angustissima
Nitzschia amphibia var. amphibia
Nitzschia holsatica var. holsatica
Stephanodiscus astraea var. minutula
Synedra acus var. acus

The standing crops of the quantitatively most significant plankters of both the lake and the marsh are depicted in Figure 4.

The plankton communities experienced vernal and autumnal pulses in both study areas (see Figure 4). According to Chandler (1940), those diatom genera which are usually dominant in the vernal plankton pulses belong to the Pennales while those which dominate the autumnal pulses belong to the Centrales. This statement holds true for both my study areas with the exception that Melosira ambigua var. ambigua and Fragilaria crotonensis var. crotonensis are major contributors to both the vernal and autumnal pulse in the lake. Patrick (1948) stated that though some diatoms may exhibit both a spring and fall pulse, usually the dominant species are different. This too is excepted by the fact that Melosira ambigua var. ambigua and Fragilaria crotonensis var. crotonensis were dominant plankters during both the spring and fall pulses in Clear Lake. However, Asterionella formosa var. formosa and Fragilaria capucina var.

mesolepta exhibited only a spring pulse in the lake. In the marsh, Fragilaria capucina var. mesolepta exhibited a strong spring pulse and a minor fall pulse while Melosira granulata var. angustissima and Stephanodiscus astraea var. minutula exhibited only a strong fall pulse. Nygaard (1938) stated that in general, lakes have major phytoplankton pulses in the spring while ponds have their major phytoplankton pulses in the summer or autumn. This appears to be true for the diatom plankton pulses in my study areas since Clear Lake exhibited its major pulse in the spring while Ventura Marsh, which is more similar to a pond than to a lake, exhibited its major pulse in September. Furthermore, the spring pulse was more sharply defined than the fall pulse in the lake while the opposite appeared to be true in the marsh.

Many workers have attempted to correlate the occurrence of diatom blooms with physical and chemical factors in the environment but the results of their efforts have frequently been contradictory. The extent of this confusion is not surprising since, as Patrick (1948) pointed out, the factors seemingly involved in initiating blooms seemed to vary from lake to lake. In the paragraphs which follow I have attempted, where possible, to correlate the appearance of diatom blooms in Clear Lake and Ventura Marsh with the physical and chemical data. It should be remembered, however, that my data are based on net plankton samples. Nonetheless, I believe some interpretation of the data is possible and appropriate.

Hutchinson (1967) stated that there is little doubt that the true spring maximum, in March or April, whether composed of diatoms or of other forms, is to be attributed largely to an increase in illumination at a time when the concentration of nutrients is high. He further stated that among the inorganic nutrients, phosphorus, combined nitrogen, and, for diatoms, silicon appear to be the ordinary limiting substances. While it is true that silica, ammonium nitrogen and nitrate nitrogen were higher in Clear Lake when or shortly after the ice melted (see Figures 3 and 4), the spring diatom pulse was not well underway until sometime after mid-April--nearly a month after the ice melted. Perhaps this delay was due to the fact that no detectable orthophosphate was present until then. Indeed, when I was able to detect high levels of orthophosphate (29 April), the lake was experiencing a massive bloom of diatoms. It is interesting to note that despite the lack of detectable nitrate nitrogen on 29 April, the diatom plankton continued to increase in density to its maximum on 13 May. Perhaps the diatoms were utilizing nitrate which was at a lower concentration than could be detected by the methods employed. However, since detectable ammonium nitrogen was present, it seems possible that the plankton diatoms were either utilizing the ammonia directly or were assimilating the nitrate nitrogen immediately upon its formation by the oxidation of the ammonia. As Lewin and Guillard (1963) pointed out, diatoms are able to utilize nitrate, nitrite and ammonia as nitrogen sources and some diatoms have been noted to preferentially utilize ammonium. Sometime after 13 May, at which time silica and, as mentioned above, nitrate nitrogen had reached undetectable levels in the lake, the spring bloom began to decline despite the fact that orthophosphate remained detectable until 10 June and ammonium nitrogen beyond that date. These data would indicate that when orthophosphate levels are sufficiently high, planktonic diatoms can multiply at such a rate as to cause a depletion of silica (provided other factors do not become limiting first). Although the fall pulse in Clear Lake was poorly defined, the plankton diatoms reached their maximum at a time (13 October) when the silica and the nitrate nitrogen levels were high (7.5 ppm and 2.0 ppm respectively) and orthophosphate was probably not limiting. On the next sampling date (27 October), the plankton diatom population had declined and orthophosphate had reached an undetectable level. Since other nutrients were still available at this time it seems possible that the low level of orthophosphate, perhaps in combination with decreasing illumination, was responsible for the cessation of the fall diatom pulse in the lake.

The spring diatom plankton pulse in the marsh is less distinct and even more difficult to interpret than that of the lake. Two spring maxima appeared, one on 29 April and one on 27 May, separated by a period of very low standing crop (13 May). On both 29 April, the time of the first maximum, and 15 April, the previous sampling date, no nitrate nitrogen could be detected. As noted earlier, I can only suggest that the diatoms responsible for this first maximum were utilizing low concentrations of nitrate nitrogen not detectable by my methods or that they were either utilizing ammonium nitrogen directly or assimilating the nitrate nitrogen as quickly as it was formed by the oxidation of ammonia. If, however, one accepts the hypothesis that nitrogen was not limiting, one is forced to look at factors other than those discussed above to explain the paucity of plantonic diatoms on 13 May. For the present, I shall consider this phenomenon inexplicable with the data at hand. On 27 May, the time of the second spring maximum, none of the nutrients considered above appeared to be limiting. Like the paucity of plantonic diatoms on 13 May, the cessation of the spring plankton pulse in the marsh cannot be correlated with nitrogen, silica, or orthophosphate levels.

The fall diatom plankton pulse in the marsh appeared during a period of low levels of orthophosphate and silica (2 September). However, on the sampling date prior to the appearance of the pulse (18 August), both orthophosphate and silica were available. Furthermore, the composition of the fall plankton (primarily *Melosira granulata* var. *angustissima*) and its density appeared to be unchanged on 15 September. This suggests that sometime prior to 2 September, the establishment of the fall pulse depleted the available orthophosphate and silica and that this plankton merely remained suspended, but static, for some time.

It is obvious from the discussion above that the activities of the planktonic diatom populations in Clear Lake and Ventura Marsh cannot be satisfactorily explained with the data available. Although this may relate in part to the methods employed, it must be remembered that diatom populations do not appear *in vacuo*. If one is to treat phytoplankton periodicity adequately, he must consider all taxonomic groups simultaneously since they interact with each other. Furthermore, the factors which simultaneously, though to varying degrees, influence the nature of the phytoplankton are so numerable as to discourage most researchers.

As Patrick (1948) pointed out, many workers have noted that *Asterionella* usually occurs earliest in the spring, and is then succeeded by other species. The work of Pearsall (1932) suggests, at least for

Asterionella gracillima (Hantz.) Heriberg, that this succession may be due to the fact that Asterionella has a higher nutritive requirement than the succeeding species. In Clear Lake, however, A. formosa var. formosa did not occur in large numbers until other taxa were well established (13 May). Nonetheless, its pulse did immediately follow a period of high orthophosphate (3.00 ppm orthophosphates were noted on 29 April).

Patrick (1948) also stated that oligotrophic conditions sometimes develop in a eutrophic lake, particularly after the bloom of a diatom species with fairly high nutritive requirements. In this connection she stated that Melosira granulata var. granulata, though it occurs in eutrophic lakes, is actually an oligotrophic taxon since it occurs after such blooms. Indeed, M. granulata var. granulata did not become a major element in the lake plankton until after a strong spring pulse of other taxa. However, its abundance at times of the year when nutrient levels were high suggests that it is truly a eutrophic taxon.

Cholnoky (1968) considered the varieties of Melosira granulata to be members of a variation series. However, despite the abundance of M. granulata var. granulata and M. granulata var. angustissima in my study areas, transition forms were not observed. Furthermore, these two taxa appear to be quite distinct ecologically. M. granulata var. angustissima was a major contributor to the plankton of Ventura Marsh, but was a rather minor element in the Clear Lake flora. The opposite situation held for M. granulata var. granulata.

A total of 56 epiphytic samples were collected from a variety of plants, 30 from the lake and 26 from the marsh. The taxa which were observed in at least 50% of the epiphytic samples from either the lake or the marsh or both study areas are listed in Table 5. Also included in this table are those taxa which, though found in fewer samples, seemed to prefer plant substrates. Of those genera included on Table 5, Gomphonema, Nitzschia and Navicula are represented by the greatest number of taxa when the two study areas are considered collectively. When considered separately, Fragilaria, Cymbella, Cocconeis and Navicula are represented by the greatest number of epiphytic taxa in Clear Lake and Gomphonema and Nitzschia in Ventura Marsh. It must be remembered, however, that some taxa are easily trapped in epiphytic growths and are not necessarily very successful as epiphytes. This is particularly true of Melosira and some Fragilaria species since they tend to form long, filamentous colonies.

Few generalizations can be made concerning plant substrate specificity since few diatom taxa exhibited a clear preference for a particular plant species. Exceptions to this include Cocconeis pediculus var. pediculus which reached its highest frequency in five lake samples, all of which were squeezings of Cladophora sp. or Rhizoclonium sp. It is interesting to note that although Rhizoclonium sp. squeezings were collected from the marsh, C. pediculus var. pediculus was not encountered there. Achnanthes hungarica var. hungarica appeared to grow most successfully on Lemna minor and Spirodela polyrhiza. Likewise, Epithemia turgida var. turgida and Rhopalodia gibba var. gibba were observed to be most successful in a mixed population of Lemna minor and L. trisulca. Although Navicula cryptocephala var. cryptocephala was found in a variety of habitats from both study areas, it was very abundant only as an epiphyte on Utricularia vulgaris in the marsh.

Thirteen surface sediment samples were collected from the lake and 11 from the marsh. The taxa which were observed in at least 50% of the epipelic samples from one or both of the study areas are listed in Table 6. Also included in Table 6 are those taxa which, though less frequently encountered, appeared to be most successful in epipelic habitats. This habitat is probably more difficult to interpret than any other habitat considered in the present study. If one considers the autecological comments for the taxa listed in Table 6, it can be seen that no fewer than six of them are most successful as plankters, seven as epiphytes and two as epiliths. Furthermore, only eight of the 31 taxa which were found in at least 50% of the epipelic samples from one or both of the study areas showed a preference for surface sediment habitats. Thus it appears that many, if not most, of the valves encountered in the surface sediment samples were transported there from other habitats. Fragilaria and Navicula were represented by more taxa exhibiting a preference for surface sediments than any other genus, five and three taxa, respectively.

Epilithic samples were collected from Clear Lake only since the rock substrates of the marsh were heavily silted over and did not represent typical epilithic habitats. As in the epipelic habitats, the majority of the taxa encountered in at least 50% of the epilithic samples exhibited no preference for rock substrates and many were more successful as plankters. From the lists on page 166 and the autecological comments of the species included in these lists, it appears that Fragilaria, Gomphonema and Navicula were represented by the most taxa showing a preference for the epilithic habitats. It is interesting to note that

Gomphonema olivaceoides var. olivaceoides and Cymbella affinis var. affinis not only appeared to be most successful on rock substrates, but reached their highest frequency there when the lake was covered with both ice and snow.

Three samples were collected from wood substrates from the lake and three from the marsh. With one exception, the taxa observed on wood substrates (see page 167) showed no preference for these habitats, but were more successful in other habitats or showed no clear habitat preference. Navicula nigrii var. nigrii was abundant in scrapings from one floating plank and very abundant from one slightly submersed plank from the marsh. With the data available, however, it is not possible to tell whether this taxon preferred the wood substrate or was favored by the high light intensity of such a habitat (or both).

One psammon sample was collected from Clear Lake. A total of 315 diatom valves were identified from this sample and the results of this count are presented on page 168. It is not surprising that the motile genus Navicula is represented by more taxa in the psammon than any other genus. As pointed out by Harper (1969), the ability to move helps the diatoms of this habitat maintain their position in the photic zone. The presence of many planktonic diatoms in this sample suggests that many of the diatoms encountered in the psammon are probably accidentals which have been transported there from some other habitat. However, that some diatoms are quite successful in the psammon is supported by the fact that Navicula platycephala var. platycephala was observed only in the psammon while Navicula decussis var. decussis and N. menisculus var. obtusa were more frequently encountered there than in any other habitat.

As part of the investigation of the flora of Ventura Marsh, two drainage ditches flowing into the marsh were sampled. Since these ditches were highly enriched with nitrate nitrogen and orthophosphate at the time of collection (see page 27), the diatom taxa which were well represented in these areas are of particular interest. The following taxa were common to very abundant in at least one of the samples collected from the ditches:

Achnanthes lanceolata var. *lanceolata*
Gomphonema angustatum var. *angustatum*
Meridion circulare var. *circulare*
Navicula nigrii var. *nigrii*
Nitzschia palea var. *palea*

The first three of the above mentioned taxa were proportionally more abundant in the drainage ditches than elsewhere while the last two taxa were as successful in other areas. With regard to the first three, however, it should be emphasized that they also appeared in other areas and that they should be considered tolerant of high nutrient levels, or perhaps even favored by high nutrient levels, but not restricted to such conditions.

It is obvious from the data presented heretofore that many diatom taxa were encountered in a great variety of habitats. This is not difficult to understand for the most abundant forms since their sheer abundance insures the eventual distribution of their frustules, though not necessarily in living condition, throughout an area. This seemed to be particularly true for planktonic forms in my study areas. Nonetheless, some taxa approached being ubiquitous since they were encountered in the majority of the samples from nearly all the habitats collected and exhibited no clear preference for any one habitat type. The following appeared to be the most widespread forms in Clear Lake:

> Achnanthes minutissima var. minutissima
> Cymbella caespitosum var. caespitosum
> Cymbella microcephala var. microcephala
> Nitzschia dissipata var. dissipata
> Nitzschia tropica var. tropica

In Ventura Marsh, Gomphonema parvulum var. parvulum and Nitzschia amphibia var. amphibia appeared to be the most widespread taxa.

As I have already noted, the simple numerical results of floristic studies (for example, the total number of taxa observed), even when they appear to be comparable in scope and intensity, provide little information as to the number of taxa a particular type of lentic environment can support relative to other lentic environments. Furthermore, the results of floristic studies do not sufficiently reveal the distribution of the taxa encountered from the standpoint of relative abundance. It would be difficult, for example, to determine with precision how many of the taxa observed in Clear Lake were represented by few individuals, how many were represented by many individuals and how many were represented by intermediate numbers of individuals if only the data discussed to this point were available.

Patrick et al. (1954) pointed out that if data obtained by counting diatoms from a sample which was representative of the area studied were treated in a manner similar to the methods of Preston (1948), a theoretical log-normal curve could be plotted and the total number of species making up a universe could be estimated. Additionally, the log-normal method allows one to estimate the distribution of the taxa within the universe from the standpoint of abundance. As a result of these features of the log-normal methods, I felt that a meaningful comparison between Clear Lake and Ventura Marsh could be made if a log-normal curve were constructed for both areas. However, the technique I employed differed from that of Patrick et al. (1954) in one major respect. They used samples collected on an artificial substrate while the data I used in constructing the two curves were obtained by counting diatoms from two composite samples containing subsamples from all the Aufwuchs and surface sediment samples from Clear Lake and Ventura Marsh, respectively. However, this approach seemed justified since Reimer (unpublished data, personal communication) has obtained meaningful results from a variety of habitats using composite samples. It must also be noted that the Aufwuchs and surface sediment samples used in preparation of my composite samples were collected over a period of several years, but this too is not unprecedented (Preston, 1948) and seems justifiable since both composite samples represent samples collected over the same period of time.

The truncated log-normal curves for Clear Lake and Ventura Marsh are presented in Figure 5. Since the heights of the modes, the theoretical universes, the number of intervals covered, the number of taxa observed, and the sigma squared values are similar for both curves, it appears that the diatom diversity and the distribution of the taxa (from the standpoint of relative abundance) are similar for the two study areas. This is of particular interest since only 126 of the 292 taxa encountered in this study were common to both study areas. Thus it appears that the diatom communities of the lake and the marsh, though floristically quite different, were structurally similar. However, these statements must be considered at least somewhat speculative until the techniques employed here have been tested further.

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ACKNOWLEDGEMENTS

For the three year duration of the present study, I have had the honor of a National Science Foundation Graduate Traineeship and am grateful to the Foundation for the support they have given me.

Few research projects ever reach completion as a result of the efforts of only a single person; the present study is no exception. I am indebted to Dr. John D. Dodd for many reasons, but mostly for having provided the environment and freedom that made this investigation possible.

I am grateful to Dr. Ruth Patrick and Dr. Charles W. Reimer of the Academy of Natural Sciences of Philadelphia for sharing their research facilities with me on several occasions. The wealth of diatom collections and literature there were invaluable to me. I am particularly thankful for Dr. Reimer's generous and candid sharing of knowledge and ideas.

I owe special thanks to Mrs. Judith Loescher for her assistance over the past three years and especially for her willingness to critically evaluate this manuscript during its development.

I extend my thanks to Dr. Charles C. Bowen and Dr. Frederick G. Smith for their kind permission to use the electron microscopy facilities at a time when my research funds were exhausted.

To all the personnel of the State Fish Hatchery at Clear Lake, Iowa, I extend sincere appreciation for their many courtesies and for sharing their facilities with me.

I express my gratitude to all members of my graduate committee for many enlightening discussions and particularly for their patience during the preparation of this manuscript.

To my wife I extend my thanks and gratitude for her help in collating the data and, especially, for having the fortitude the last few years have required.